The FOUNDRY

Volume 48. No. 21
Whole No. 358

Published
Semimonthly

CLEVELAND, OHIO, NOVEMBER 1, 1920

Plow Points Made on Quantity Basis

Production of the Same Line of Work for Many Years Has Resulted in the Development of Extremely Efficient Methods and Equipment for Making the Molds

AGRICULTURE still is the main industry of the United States and probably will remain so as long as there are vast tracts of arable land. No matter what industries grow up nor how many men are engaged in them, the basic fact remains that the population must be fed and clothed. Statistics show the valuation placed on the farms as going concerns exceeds that of any other industry, that the volume of material raised on the farm exceeds that of any manufactured article and that after making due allowance for the amount devoted to home consumption, the volume and value of agricultural exports exceeds that of any other products exported from our shores.

The transportation and shipping of this vast amount of material will not be considered at this time, although castings play an important part in the transportation industry both by land and water. Neither is it desired to dwell on how essential machinery is to harvesting the crops. This article is a discussion of foundry practice in a plant which specializes in the production of plows, horse and power drawn, single, double and gang plows, used in the cultivation of the ground on which the crops are grown. The Vulcan Plow Works, Evansville, Ind., is an old established concern which has grown and expanded steadily practically from its inception in the days closely following the Civil war. In addition to its domestic business which is handled in carload lots of plows and accessories by dealers all over the country, it exports plows to practically every country in the world. An addition to the plant has been completed recently which approximately doubles the capacity and it is anticipated will care for expanding business for several years to come.

The foundry building is divided into three sections by two brick walls which extend part way across the building, leaving one continuous pas-

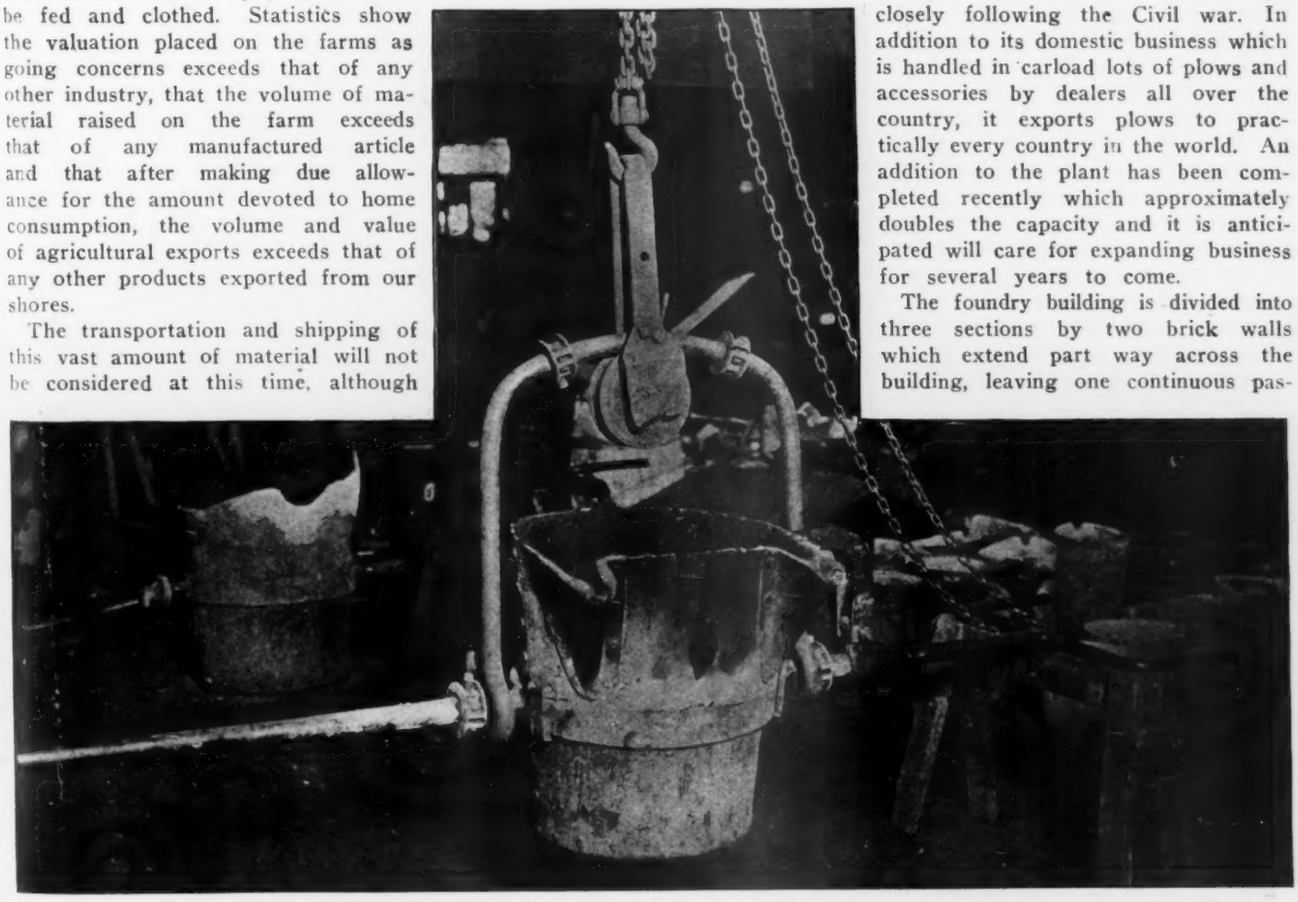


FIG. 1—SPECIAL LADLE PROVIDED WITH TWO LIPS FOR POURING TWO STACKS OF MOLDS AT ONE TIME

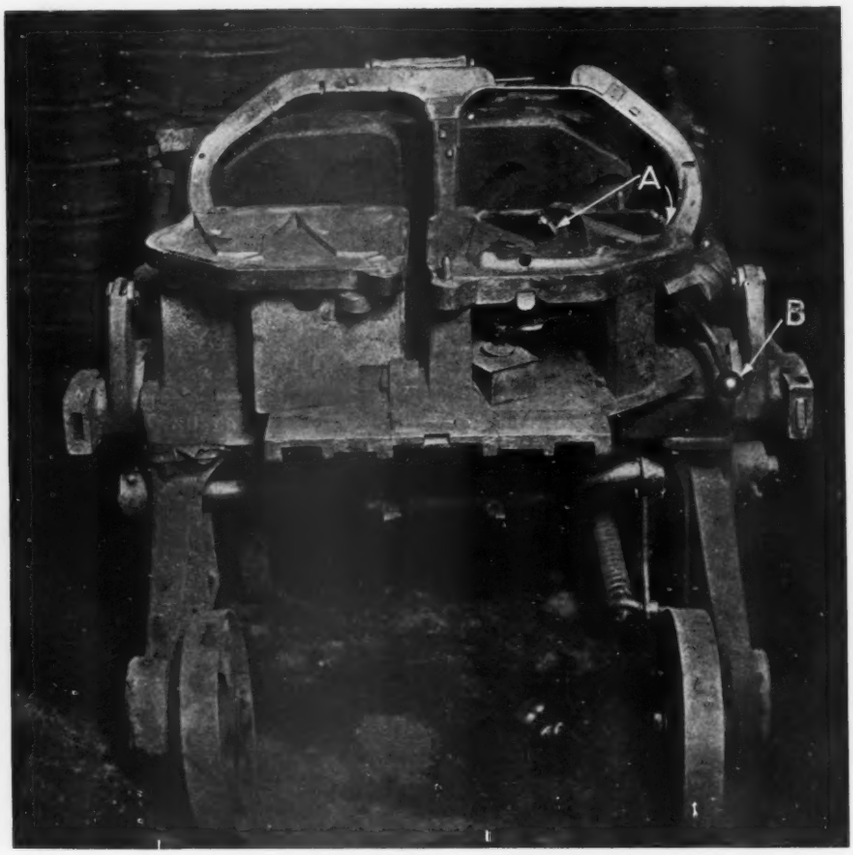


FIG. 2—COPE AND DRAG ARE SQUEEZED AT ONE OPERATION

sage on one side of the building from one end to the other. A monorail 10 feet from the floor follows this passage and serves to convey the iron to the various floors in the afternoon and to carry the castings from the molding floors to the cleaning room at night.

One section of the building is devoted altogether to the production of plow points on a battery of hand power squeezers made by the Adams Co., Dubuque, Iowa. The middle section is equipped with two machines made by the Rathbone Molding Machine Co., Detroit, a company no longer in existence, and one small pneumatic bumper made by the Arcade Mfg. Co., Freeport, Ill. The third division is used for making the land sides, mold boards and the wheels, sprockets, housings, bearings and other cast iron parts entering into the manufacture of tractor plows.

Taking them in the order indicated a fair idea of the way plow points are molded may be gained from an examination of the illustrations shown in Figs. 2 and 3. It will be noted that the machine is mounted on wheels which enables the operator to push it along, keeping close to his diminishing sand pile and minimizing the distance he is obliged to carry each mold. One machine is supplied for each floor and one man operates each machine. The construction of the pattern plates and the method of mounting them on the machine is clearly indicated in the illustration, Fig. 2. The plates are made of cast iron approximately 1½ inches thick at the edges and accurately machined and fitted. Suitable pin holes are bored in one and pins inserted in the other corresponding to similar pins and pin holes in the flasks. The flasks also are planed both top and bottom and the pins and pin holes fitted accurately. Both cope and drag plate are mounted on one machine and are elevated on suitable stands about 8 inches above the regular table. This extra distance is to provide room to operate the stripping device attached to the lever *B*, Fig. 2. The cope pattern plate is perfectly plain, the edges of the patterns are drafted generously and therefore no difficulty is experienced in securing a clean lift.

However, the drag is different. The flanges on the patterns are set at rather an acute angle, in foundry parlance they are *undercut,* and therefore if they

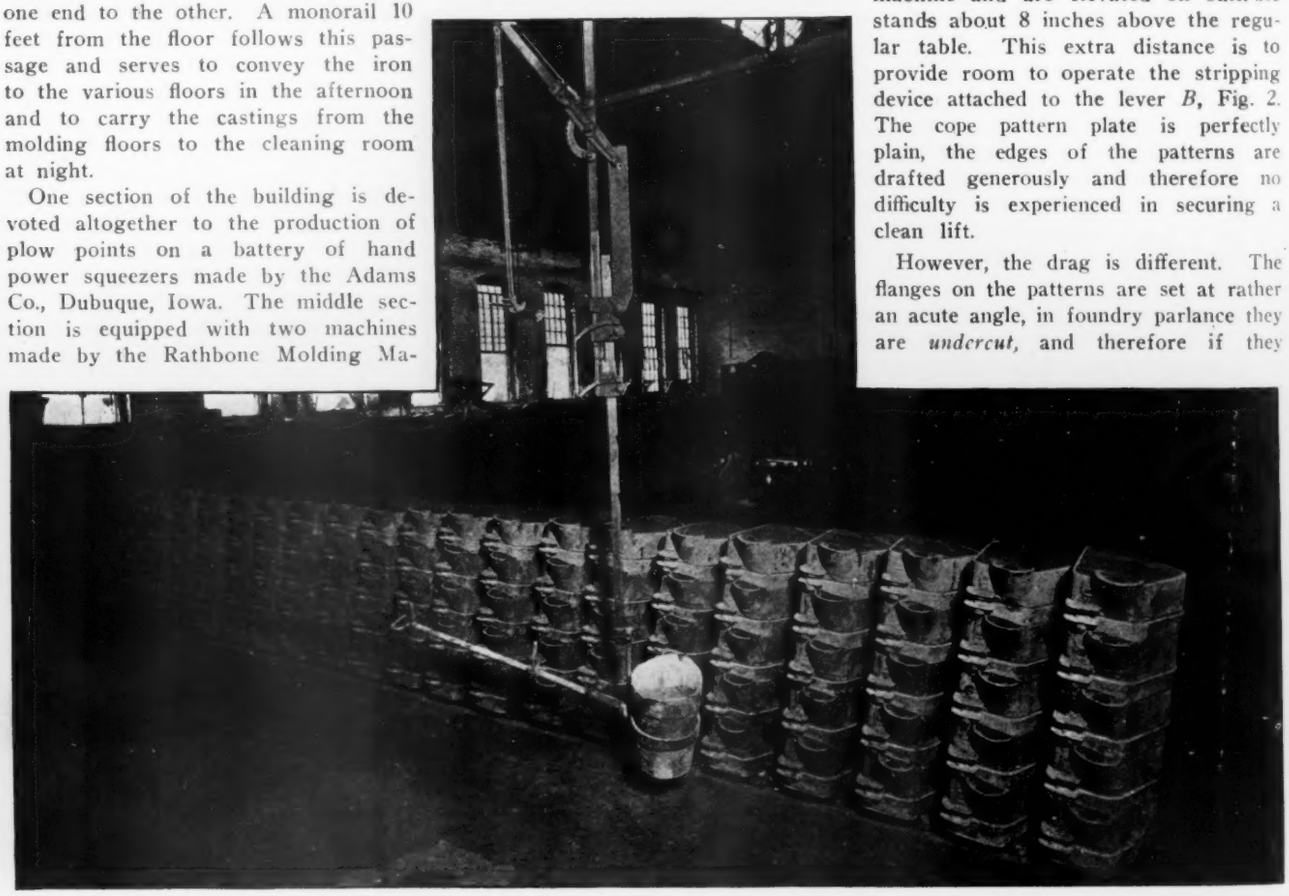


FIG. 3—THE FLASKS ARE STACKED FIVE HIGH BUT ARE POURED ONE AT A TIME

FIG. 4—THE FLASKS ARE RAMMED ON A SPECIAL MACHINE WHICH PRODUCES A COPE IMPRESSION ON ONE SIDE AND A DRAG IMPRESSION ON THE OTHER SIDE OF THE SAME FLASK

were attached rigidly to the remainder of the patterns it would be impossible to lift the sand. To provide for this contingency the flanges on the patterns are made separately and work through suitable slots provided for that purpose in the pattern plate. They are connected under the pattern plate with a toggle and lever arrangement which serves to strip them out of the mold before the flask is lifted off.

The sand frame for holding the extra sand before the squeezer head is brought down is shown standing immediately back of pattern plates. It will be noted also that the squeezer head, partly shown, is provided with a number of depressions which come over the high points in the patterns. This feature obviates the danger of squeezing some parts of the mold harder than others owing to the relatively closer proximity of the board.

Efficiency Achieved

Due to the exceptionally efficient rigging it is possible to train green help in a comparatively short time to produce a maximum number of plow points for a day's work. All the work is paid for on a piece work basis and the average day's output for an experienced man is 175 flasks or 350 plow points. The discount averages about 2 per cent.

All the sand in the three sections of the foundry is cut over by colored helpers operating a sand cutting machine made by the company. The vanes are narrow and are set to a small circle and the whole machine is so balanced that when it hits an obstruction

FIG. 5—PLOW POINT MOLDS STACKED FOR POURING—A DAY'S WORK IN THE FOREGROUND TOTALING 880 CASTINGS

in the sand it automatically clears itself. The helpers who cut the sand go in to work about 5 o'clock in the morning and when the molders start to work the sand is fresh.

The necessity for planing both top and bottom joints of all the flasks is apparent when it is remembered that they are not provided with bars and the machines are set to ram them all alike. Any variations in the height of the flasks would affect the density of the rammed sand. However, the principal reason for planing the flasks is because they are stacked five high and poured in that position. The bottom face of each mold serves as a cover and weight for the mold under it and it is essential that they sit snugly on top of each other to prevent the static pressure of the iron from forcing the sand through the copes. A flat iron weight is placed on the topmost cope.

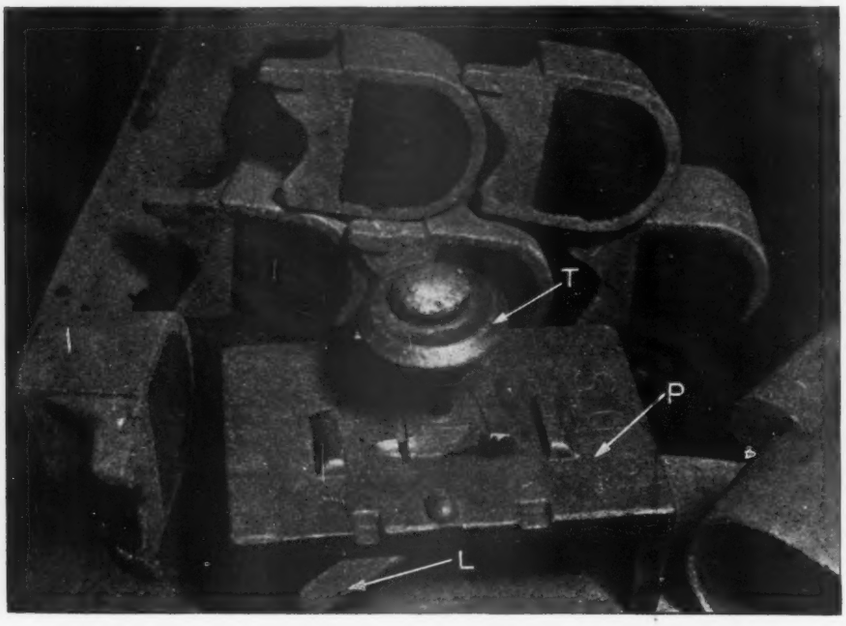


FIG. 6—THE RUNNER CUPS ARE MADE ON THE PLATE SHOWN IN THE FOREGROUND

The flasks are made to conform closely to the shape of the pattern and also are of a minimum depth. These two features effect a material saving in the amount of sand necessary to put up the floor. As will be noted in the illustration, Fig. 3, the cope is provided at one end with a little extension or pocket in which the pouring basin is located. This pouring basin and sprue is formed at the same time and by the same action which rams the mold proper. When the lever is released all the molder has to do is to lift the drag off the machine, turn it over and set it down, either on a plate, if it is the first one of the stack; or on top of the preceding mold if the stack has been commenced. The lever *B*, Fig. 2, is then lifted which releases the flanges, *AA*, by drawing them down through the slots in the plate. The cope is then lifted off and placed on the drag; after which the action of the lever *B* is reversed, forcing the flanges up into their places and another flask is placed on the machine and rammed in a similar manner.

Although the flasks in this section of the shop are stacked, they are poured individually by the device shown in the illustration, Fig. 3. A rail paralleling the row of molds extends over each floor from side to side of the building. Iron is conveyed from the cupola in a large ladle suspended from a monorail which has been previously referred to. Each floor is provided with a device similar to the one shown in Fig. 3. It is pushed out to the gangway and the ladle filled from the large ladle, after which it is taken back and the molds poured in regular order commencing at one end. The ladle is designed to pour one stack at a time. The quadrant arm and notched steel bar enable one man to manipulate the ladle alone. In pouring the stack he commences at the bottom and pours up. This method serves a double purpose, it prevents any drips from falling into an open gate as might happen if he commenced at the top; and it also lightens the load which has to be hoisted. By the time the highest mold is reached the ladle is almost empty. Each man pours off his own work, but the flasks are shaken out by another crew, who stack them, pull out the castings which they pile near the gangway, and the chills which are piled at a convenient point for next day's operations.

The middle section of the foundry has been set apart almost entirely for the production of plow points on two pneumatic multiple molding machines which were made by the one-time Rathbone Molding Machine Co., Detroit. A view of the machine and sand handling equipment together with the way the flasks are piled on top of each other is shown in Fig. 4. The floor at 11:30 a. m., together with the 880 castings from the previous day's heat are shown in Fig. 5. This machine and auxiliary equipment were described at length in THE FOUNDRY for March, 1909, at which time they recently had been installed. Some of the claims made for it at that time have not been borne out but the fact that one man and a helper succeed in turning out 880 castings a day with an average loss of 1 per cent would seem to indicate that the machine is efficient.

Flask is Both Cope and Drag

The management admits that the machine exceeds the output on their hand machines, but they also claim that when the relative cost of operating the two styles of equipment is compared there is not much in favor of the multiple machine. Furthermore it has been found by experience that it is much easier to develop molders who could reach a maximum production on the hand squeezers, than on the multiple machine.

The idea embodied in the machine and equipment is exceedingly ingenious and could be adapted to other uses. The sand is all passed through a revolving riddle which discharges into a bin in the floor from which it is conveyed by a bucket elevator and deposited in a hopper close to the molding machine. The bottom of the hopper terminates in a loose frame provided with a movable bottom and top plate. This frame is designed to hold just the correct amount of sand to fill a flask for ramming. In practice the flask is placed on the machine; the operator pulls the box full of sand toward him. It is supported on a long arm which carries it in a horizontal plane level with the top of the flask. The same action that pulls the box from under the hopper automatically pulls the top plate into place and prevents the remainder of the sand from pouring out of the hopper. A chain attached to the bottom plate becomes taut just as the edge of the sand box reaches the empty flask; consequently by the time the sand box has been pulled all the way across the flask it is simply an open frame and all the sand is in the flask. The operator then shoves it back under the hopper and of course the different actions are reversed. The bottom plate assumes its place underneath the frame and the top plate is pushed back allowing the sand to descend from the hopper and fill the box for the next

flask. It will be noted that it takes considerably longer to describe the operation than it does to carry it out in actual practice. The men work nine hours a day but since they spend about an hour shaking out, they only spend about eight hours molding. In that time one man rams 960 separate flask parts or practically two per minute.

Stacking and Pouring the Molds

On this machine both cope and drag impressions of the mold are made on each section of the flask. When they are stacked, the drag face of the second flask forms the cope of the one preceding and so on to the top. From this it follows that two half molds are wasted on each stack; the bottom face of the first flask rammed and the top face of the uppermost flask. Iron bottom plates provided with a projecting surface corresponding to the shape of the patterns are used to receive the first drag. The projections fill the empty space on the bottom side and prevent the lower molds from straining. Sand is packed in the open space in the top flask and scraped off flush with a straight edge. A flat weight is placed on top of each stack of molds and in addition a pair of light spring clamps are attached to the four upper sections.

The stacked flasks in this section are poured through one long upright runner extending from the top to the bottom. A plug attached to the pattern plate leaves a hole through each flask section. A short piece of core is used in the bottom drag of each stack to fill the hole. These flasks are so comparatively shallow that it is necessary to use a pouring cup on the top cope to prevent shrinkage. Some of these cups together with the device employed for ramming them are shown in Fig. 6.

It is customary to ram the cups in the barrow containing the sand as shown in the illustration. The plate *P* rests on a short piece of board. The lever *L* is attached by a bolt which permits it to swing from side to side. The plunger *T* also is loose and is shown in the illustration with the lower end resting on the lever *L*. The sand strip designed to make a tight joint around the sprue is present on every flask and also is provided on the plate on which the runners are made. It shows quite plainly on the bottom side of the cups in the illustration. To make the cup, the plate is set up as shown and one of the cups set on. It is located definitely by the two lugs shown, one at each side and by the two depressions shown in the edge of the plate. After the cup is located the helper throws in a small shovel full of sand, then he swings the lever *L* to one side, and hits the plunger with a wooden mallet. This rams the sand and forms a conical pouring cup. The plunger is then withdrawn, the cup lifted off and another set on, and so on until a cup has been made for every stack of flasks on the floor.

To secure a maximum output the multiple molding machine is employed exclusively on a few styles of plow points. The machine is equipped with a pair of electric magnets in the top plate which serve to hold the light chills used on that face in position until the sand is rammed. The large chills along the extreme point and the one edge are set in what corresponds to the drag face of the mold after the flask has been removed from the machine, but the two small chills which are placed on certain plow points at two places on the inside are attached as described. One man does nothing but ram the molds and set the chills; the other gathers the chills and oils them and sees that there is a constant supply on hand. He also prepares the sand, brings stacks of empty flasks and lowers them off at a convenient point for the man at the machine, takes the stacks of completed molds away as fast as they are ready and makes up the runners.

For shaking out the molds the same yoke and slings shown in the illustration, Fig. 4, is used. However, in addition to the yoke and slings, a device comprising two stout steel rods terminating in toes at right angles and fitting snugly under the base of the air hoist cylinder at one end and fastened securely into a flat iron plate a few inches smaller than the inside dimensions of the flasks is employed. The slings are adjusted to the lugs on the bottom flask; then as the flasks are lifted the plate remains stationary and forces all the sand out through the bottom. On account of the sand strip around the inside bottom edge of the flask they cannot be stripped entirely clean but the small amount of sand remaining is easily knocked out afterward by the flask man.

FIG. 7—SPECIAL ROLL-OVER AND PATTERN DRAWING DEVICES

Small deep gear housings are made on the Arcade bumper shown in Fig. 7. The trunnions on the side of the flask are located above the center of gravity and as soon as the flask is rammed up the bail shown at *O*, Fig. 7, is attached. The operator pulls on the rope which runs over a block hooked to a beam and the flask swings right over. The ingenious little homemade device shown at *R* is employed for drawing the pattern. Two toes rest on the lugs of the flask. A plunger working through a long bearing is attached at the lower end to the pattern by means of a bolt. A light wire rope attached to the upper end of the plunger and running over a small pulley is carried down and wound on a drum which in turn is actuated by the crank shown in

the operator's hand. When drawing the pattern he starts the vibrator and at the same time winds up on the drum. After the pattern has been withdrawn from the mold it is detached from the pattern drawing device and the latter is hung up on the bracket shown at *K*. In like manner the bail for rolling the flasks over is pushed out of the way as indicated in Fig. 7.

The special ladle shown in Fig. 1 is employed for pouring the stacked plow point molds made in this section of the shop. It is provided with two lips and is used for pouring two stacks at one time. It is provided with a substantial safety catch at one side to prevent it from tipping while on its way from the furnace or at any other time when it might be necessary for the man to release his hold on the double shank end. The bail is supported on a sheave wheel forming part of a yoke suspended from a chain hoist. By this arrangement it is possible to tilt the ladle far enough to pour out of one lip if necessary. Safety collars on each side of the bail insure that the ladle will not tip too far and thus become unmanageable.

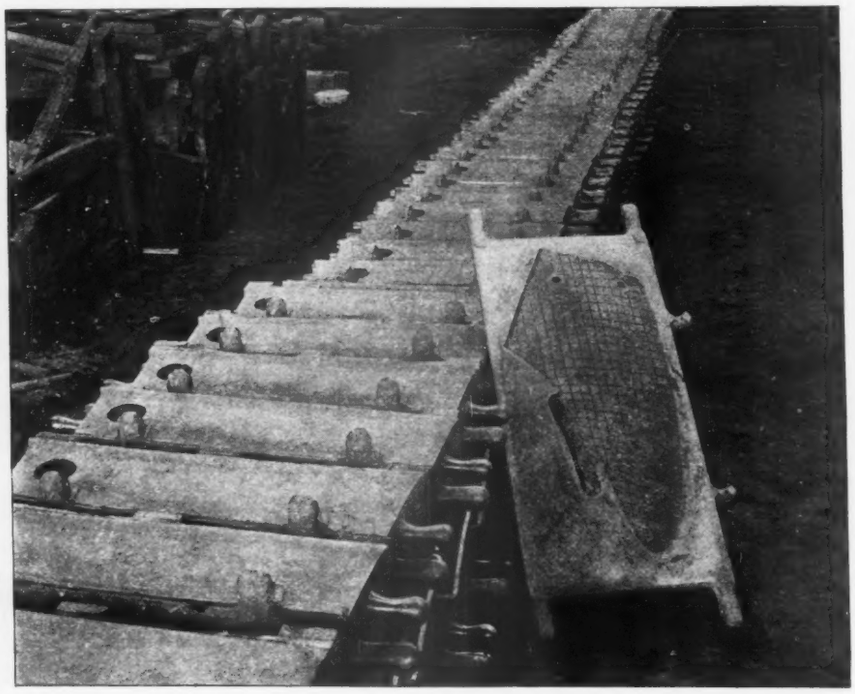


FIG. 8 A FLOOR OF MOLD BOARD MOLDS—THE CASTING IS POURED AGAINST A CHILL WHICH FORMS ONE COMPLETE SIDE OF THE MOLD—THE OTHER SIDE IS MADE IN A FLASK IN GREEN SAND

Mold Boards are Annealed

The methods and rigging employed in making the mold boards are shown in Fig. 8. They are made in the third and largest unit of the foundry. Here also are made the land sides, wheels, sprockets, gears and all the other miscellaneous parts entering into the construction of plows. At times a considerable amount of jobbing work is made in this section, including repair parts for the machines and appliances used in the other shops of the company. John Danheiser, the foundry superintendent, has developed a semi-steel mixture for the anvil blocks and dies used in the blacksmith shop which stands up for an unusually long time under this exacting service.

Several mixtures are poured from the regular heat each day. The mold boards which must be both hard and tough are poured from a low silicon mixture containing 12 per cent charcoal iron. The drag part of the mold in which the mold boards are made consists of an iron plate the top side conforming to the shape of the casting and the lower side hollowed out roughly to give approximately the same thickness of metal in every part. As may be seen from the illustration, the flasks are turned up on edge for pouring. The runner goes to the bottom and the iron fills the mold gradually from that point. The four small holes in the face of the chill are core prints and the scored lines running at right angles all over the face are designed to hold the iron as it commences to congeal and prevent hollow places on the face of the casting. These lines are afterward ground off when the mold board reaches the grinding room.

When these castings are poured they are exceedingly brittle and must be handled with great care. They are taken to several brick lined pits while still hot and buried in hot sand for 36 hours after which they may be handled safely.

The plow points are poured from a slightly higher chilling mixture, about 1.20 per cent silicon; the land sides which must be hard but not chilled, are poured next from iron having a silicon content of about 1.50 per cent and the miscellaneous castings, most of which must be machined are poured last from iron approximating 2.25 per cent silicon.

A mixing ladle located under the spout of the cupola is used to insure a uniform grade of metal. Transverse tests are made every day and chemical analyses are made at regular intervals to maintain a line of castings having the same physical characteristics.

Westinghouse Completes Foundry Addition

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has added a new foundry building, 120 x 200 feet, to its South Philadelphia works. The architecture of the building is of *daylight* design with the skylight glass beginning about 3 feet 7 inches from the ground and extending over the entire building which at the highest point is about 26 feet.

This foundry will be used to make castings that weigh from ½-pound to ½-ton. The larger castings, weighing from ½ ton upwards to 150 tons, will continue to be made in the large foundry, 187 x 650 feet. The new building was erected to help take care of the new shops that were recently completed, namely a machine shop, which adds 139,000 square feet, and the 300-foot extension of the erecting shop, now a 150 x 850-foot building with a balcony of the extreme length, 42 feet wide.

Other additions recently finished are, a 3-story warehouse, with 86,650 square feet of floor space; two pattern storage buildings, 30 x 258 feet, and two garages that accommodate a total of 60 automobiles.

Phila Foundrymen Meet

The first of the monthly meetings since the summer recess was held by the Philadelphia Foundrymen's association at the Manufacturers club of that city on Wednesday evening, Sept. 8, 1920, at 8 o'clock. F. J. Ryan, general manager of the American Metallurgical corporation, Philadelphia, and a fellow member of the association addressed the meeting on the subject, "The Future of Electric Heat as Applied to the Iron, Brass and Steel Foundry." The talk was illustrated by a number of lantern slides.

Growth Marks Reconstruction Era

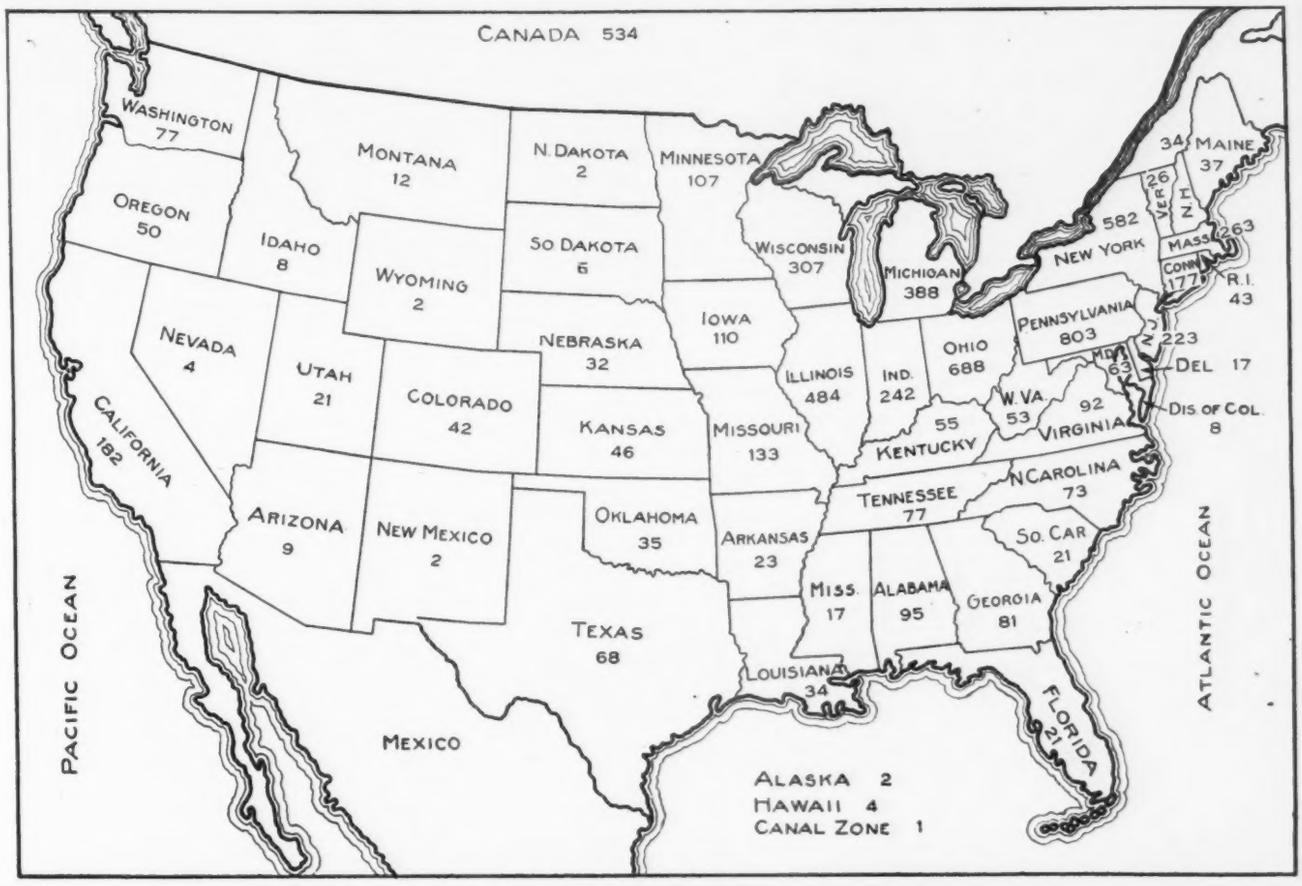
Demand for Castings During the Period Following the Armistice is Reflected in New Foundries Built—Gray Iron Shops Lead Through Automotive's Aid

IMMEDIATELY following the armistice, when the foundry industry paused to take stock of its condition, the feeling was expressed that plant facilities during the war had been expanded beyond the normal needs of the country. Demand for castings during the following six months seemed to support this assertion, until with the automotive industry in the lead an unprecedented volume of business was brought to foundries in all sections of the country. Then, throughout 1919 and extending into the present year came an insistent and increasing call for castings, gray iron, malleable, nonferrous and steel, which was met by constructing new plants and by expanding those already in existence. A survey just completed by THE FOUNDRY gives indication of the way in which the industry has rounded the corner on the reconstruction period.

That the total number of foundries in the United States and Canada is shown to be greater at this time than in 1918, when the last survey was made, is only one of many indications of the growth which has taken place. The total number of casting plants at this time is 6516, marking an increase of 72 over the 1918 total of 6444. The war period, covered by 1916, 1917 and 1918 saw a greater increase in numbers of plants, but it is doubtful if the expansion in existing establishments was as great during that time as it has been during the past two years. Conditions have been more conducive to plant construction during the early portion of the past two years. The demand came in advance of the tremendous increase in building costs, and therefore many establishments built additions, and installed new equipment unhampered by the factor of high building and material costs which has entered in the past months. Further, with the prospect of still greater prosperity, many foundries have thought it advisable to expend a portion of their earnings in plant betterment and additions which will show on the credit side in plant inventories, and will provide facilites for further increased business.

The great expansion of the industry not only in number of plants, but in extensions may best be judged by the reports of the growth in consumption of raw materials which have been commented upon from time to time in THE FOUNDRY.

The total number of foundries in the United States, alone, at the present time is 84 greater than in 1918. The present listing shows a total of 5982 shops in this country and its possessions, while the census taken two years ago showed 5498. Canada again shows a decrease in the number of foundries listed, this year's figures showing 534 as compared with 546 in 1918. The slight loss in Canada as compared with the gain in the United States may in measure serve as an indication of the character of the foundries which have



TOTAL NUMBER OF FOUNDRIES IN THE UNITED STATES AND CANADA, OCT. 1, 1920

TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1918

GRAY IRON FOUNDRIES IN THE UNITED STATES AND CANADA, OCT. 1, 1920

STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, OCT. 1, 1920

come into existence in the past two years. The demand for automobile castings and the appurtenances connected with the automotive industry undoubtedly has contributed greatly to the growth in the number of foundries in this country. Canada has not experienced this demand to as great a degree, and further many of the foundries above the border, which at the completion of the last listing were engaged in war work, today are inoperative. Some of the latter, undoubtedly have been converted to other lines, but the stimulus has not been as great in many lines as it has been in the United States.

Gray iron foundries show the greatest increase with a net gain of 70

TABLE I

Iron and Steel Foundries 1920-1918

TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1920 AND 1918.

United States and Canada, 1920	6516	
United States and Canada, 1918	6444	
Total foundries, gain		72
Foundries, United States, 1920	5982	
Foundries, United States, 1918	5898	
Gain in the United States		84
Foundries in Canada, 1920	534	
Foundries in Canada, 1918	546	
Loss in Canada		12

GRAY IRON FOUNDRIES IN THE UNITED STATES AND CANADA, 1920 AND 1918.

United States and Canada, 1920	4857	
United States and Canada, 1918	4787	
Total gray iron increase		70
Gray iron, United States, 1920	4397	
Gray iron, United States, 1918	4325	
Increase in the United States		72
Gray iron, Canada, 1920	460	
Gray iron, Canada, 1928	462	
Decrease in Canada		2

MALLEABLE FOUNDRIES IN THE UNITED STATES AND CANADA, 1920 AND 1918.

United States and Canada, 1920	267	
United States and Canada, 1918	268	
Decrease		1
United States, 1920	242	
United States, 1918	249	
Decrease		7
Canada, 1920	25	
Canada, 1918	19	
Increase		6

STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1920 AND 1918

United States and Canada, 1920	449	
United States and Canada, 1918	426	
Increase		23
United States, 1920	409	
United States, 1918	390	
Increase		19
Canada, 1920	40	
Canada, 1918	36	
Increase		4

ELECTRIC STEEL FOUNDRIES IN THE UNITED STATES AND CANADA 1920-1918

United States and Canada, 1920	206	
United States and Canada, 1918	161	
Increase		45
United States, 1920	185	
United States, 1918	143	
Increase		42
Canada, 1920	21	
Canada, 1928	18	
Increase		

foundries for both the United States and Canada. The totals for 1918 and 1920 are 4787 and 4857, respectively. In this class of casting plants, Canada shows a loss of two shops in the past two years, while the United States has a gain of 72 gray iron foundries, which is in keeping with the reason assigned for the difference in showing made in the total number of plants listed. Canada has 460 gray iron shops at the present time, while in 1918 there were 462 in the Dominion.

The totals shown in the malleable industry are significant of an industrial tendency. While the total of foundries in the United States is 242 as compared with 249 in 1918, the output of malleable castings has increased by perhaps 25 per cent in the past 18 months alone. The reason is obvious. Existing plants have been enlarged in many cases, and mergers have been effected so that the operating establishments at this time have greater facili-

TABLE II
Nonferrous Foundries 1920-1918

TOTAL EXCLUSIVE BRASS FOUNDRIES AND BRASS DEPARTMENTS OF OTHER PLANTS IN THE UNITED STATES AND CANADA, 1920 AND 1918.

United States and Canada, 1920	3482
United States and Canada, 1918	3472
Increase	10
Total Brass, United States, 1920	3163
Total Brass, United States, 1918	3159
Increase	4
Total Brass, Canada, 1920	319
Total Brass, Canada, 1918	313
Increase	6

EXCLUSIVE BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, 1920 AND 1918.

United States and Canada, 1920	1316
United States and Canada, 1918	1280
Increase	36
Exclusive Brass, United States, 1920	1263
Exclusive Brass, United States, 1918	1218
Increase	45
Exclusive Brass, Canada, 1920	53
Exclusive Brass, Canada, 1918	62
Decrease	9

BRASS DEPARTMENTS OF GRAY IRON, MALLEABLE AND STEEL FOUNDIES IN THE UNITED STATES AND CANADA, 1920-1918.

United States and Canada, 1920	2167
United States and Canada, 1918	2192
Decrease	25
Brass Departments, United States, 1920	1901
Brass Departments, United States, 1918	1941
Decrease	40
Brass Departments, Canada, 1920	266
Brass Departments, Canada, 1918	251
Increase	15

FOUNDRIES MELTING ALUMINUM IN THE UNITED STATES AND CANADA, 1920 AND 1918.

United States and Canada, 1920	2363
United States and Canada, 1918	2230
Increase	133
United States, 1920	2169
United States, 1918	2039
Increase	130
Canada, 1920	194
Canada, 1918	191
Increase	3

MALLEABLE FOUNDRIES OF UNITED STATES AND CANADA, OCT. 1, 1920

TOTAL FOUNDRIES MELTING BRASS; UNITED STATES AND CANADA, OCT. 1, 1920

EXCLUSIVE BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, OCT. 1, 1920

ties and produce a greater tonnage with fewer separate and distinct plants. In Canada, the malleable shops have increased by six, the present total being 25 as compared to 19. The loss in number of plants in both the United States and Canada has for this reason been only one, the total this year being 267 as compared with 268.

Steel foundries have increased both in the United States and Canada during the past two years, despite the lessened demand for steel castings following the war. Probably some of the shops which are listed were under construction at the time of the armistice. Others have been built in regions which were not provided with steel casting facilities sufficient to meet the local demand, and many have been added as departments of large manufacturing enterprises. The total number of steel foundries now is 449, making an increase of 23 or 5.4 per cent over the 1918 total of 426. Canada now has 40 steel foundries as contrasted with 36 shown in 1918, while the United States shows a net gain of 19, increasing from 390 to 409 plants in period mentioned. One of the most remarkable features of the survey is the increase noted in foundries using electric furnaces in making steel. Two years ago there were 161 foundries using this type of melting furnace and today there are a total of 206. This is an increase of 45 or 28

TABLE III

Foundries of the United States and Canada in 1920 and 1918 by States and Provinces.

	Total foundries 1920	Total foundries 1918	Increase or decrease in two years	Gray iron foundries 1920	Gray iron foundries 1918	Exclusive brass foundries 1920	Exclusive brass foundries 1918	Brass foundries departments of other shops 1920	Brass foundries departments of other shops 1918	Total brass foundries 1920	Total brass foundries 1918	Malleable iron foundries 1920	Malleable iron foundries 1918	Steel foundries 1920	Steel foundries 1918	Foundries melting aluminum 1920	Foundries melting aluminum 1918	Electric steel foundries 1920	Electric steel foundries 1918
Alabama	95	85	+10	88	79	5	6	34	33	39	39	3	2	5	5	21	16	2	2
Alaska	2	2	..	2	2	..	..	1	1	1	1	..	..	1	1	..	..	1	1
Arizona	9	9	..	9	9	..	..	9	9	9	9	..	..	1	2	4	5	..	..
Arkansas	23	22	+ 1	20	17	3	4	15	13	18	17	..	..	1	1	11	9	1	..
California	182	176	+ 6	126	129	50	41	74	81	124	122	4	4	19	16	97	94	11	9
Canal Zone	1	1	..	1	1	..	..	1	1	1	1	..	..	1	1	1	1	..	..
Colorado	42	46	— 4	33	37	8	9	19	17	27	26	..	..	5	5	17	17	4	3
Connecticut	177	170	+ 7	97	88	65	63	39	38	104	101	14	17	5	6	72	59	4	3
Delaware	17	15	+ 2	6	8	8	5	5	5	13	10	1	1	4	4	6	4	..	..
Dist. of Columbia	8	6	+ 2	6	6	2	..	3	2	5	2	..	..	3	2	5	2	2	2
Florida	21	19	+ 2	20	18	1	1	20	18	21	19	1	..	..	..	19	13	..	..
Georgia	81	72	+ 9	76	68	5	4	50	48	55	52	..	..	2	3	35	26	1	1
Hawaii	4	4	..	4	4	..	..	3	3	3	3	..	..	..	..	1	2	..	..
Idaho	8	8	..	8	8	..	..	8	8	8	8	..	..	..	..	8	8	..	..
Illinois	484	491	— 7	328	336	120	106	90	118	210	224	31	34	26	38	179	155	11	17
Indiana	242	243	— 1	181	180	44	44	69	55	113	99	17	16	11	16	72	65	6	6
Iowa	110	109	+ 1	96	97	8	6	46	42	54	48	3	2	7	6	43	38	3	1
Kansas	46	47	— 1	42	44	3	2	30	29	33	31	2	2	1	1	28	27	..	..
Kentucky	55	55	..	41	42	14	11	15	17	29	28	..	1	1	2	19	18	..	..
Louisiana	34	33	+ 1	29	27	5	4	20	21	25	25	1	1	3	3	13	9	1	1
Maine	37	43	— 6	30	37	7	7	23	27	30	34	..	..	..	..	15	14	..	..
Maryland	63	70	— 7	44	49	18	18	24	24	42	42	1	3	4	5	23	23	1	1
Massachusetts	263	275	—12	165	171	88	87	55	57	143	144	3	4	17	16	99	104	7	5
Michigan	388	353	+35	253	232	108	94	82	90	190	184	17	16	18	19	133	129	8	8
Minnesota	107	112	— 5	91	94	13	11	49	48	62	59	2	3	9	8	48	45	4	4
Mississippi	17	20	— 3	17	20	..	..	17	20	17	20	..	..	..	..	7	9	..	..
Missouri	133	128	+ 5	105	95	27	27	44	34	71	61	6	6	5	7	50	40	1	2
Montana	12	12	..	12	12	..	..	11	11	11	11	..	..	..	..	7	7	..	..
Nebraska	32	28	+ 4	28	24	4	4	19	20	23	24	1	..	2	1	21	20	1	..
Nevada	4	4	..	3	3	1	1	3	3	4	4	..	..	..	..	3	3	..	..
New Hampshire	34	37	— 3	29	29	5	7	16	16	21	23	1	2	1	..	16	19	1	..
New Jersey	223	250	—27	153	161	61	79	53	50	114	129	8	5	7	6	78	84	2	2
New Mexico	2	2	..	2	2	..	..	2	2	2	2	..	..	..	..	2	2	..	..
New York	582	570	+12	399	382	151	157	180	177	331	334	29	30	28	20	203	212	16	8
North Carolina	73	62	+ 9	72	60	1	2	51	42	52	44	2	3	1	2	39	28	1	1
North Dakota	2	2	..	2	2	..	..	1	2	1	2	..	..	..	..	1	2	..	..
Ohio	688	656	+32	464	434	176	166	123	134	299	300	42	36	52	47	193	192	27	17
Oklahoma	35	32	+ 3	31	28	3	4	20	18	23	22	1	..	3	1	18	18	2	1
Oregon	50	45	+ 5	44	39	4	3	28	25	32	28	1	..	7	4	24	19	3	3
Pennsylvania	803	806	— 3	606	614	143	138	209	230	352	368	24	32	100	86	229	212	31	16
Rhode Island	43	44	— 1	27	28	13	14	11	12	24	26	1	1	1	1	20	19	..	..
South Carolina	21	22	— 1	21	22	..	..	19	18	19	18	..	..	1	..	12	10	1	..
South Dakota	6	7	— 1	6	7	..	..	3	6	3	6	..	..	..	..	3	4	..	..
Tennessee	77	74	+ 3	72	71	5	3	34	40	39	43	1	3	2	3	27	24	..	..
Texas	68	64	+ 4	56	55	12	9	38	35	50	44	1	..	5	4	33	28	3	2
Utah	21	19	+ 2	21	19	..	..	15	15	15	15	..	1	2	2	9	10	1	1
Vermont	26	24	+ 2	25	23	2	1	14	15	16	16	..	..	..	..	11	8	..	..
Virginia	92	92	..	89	90	3	2	63	65	65	67	3	2	7	4	43	38	5	3
Washington	77	89	—12	62	74	12	12	36	44	48	56	..	..	12	12	40	37	10	10
West Virginia	53	51	+ 2	44	42	6	6	27	26	33	32	1	1	4	4	19	18	..	..
Wisconsin	307	290	+17	210	205	58	59	79	75	137	134	20	21	25	26	91	92	13	13
Wyoming	2	2	..	1	1	1	1	1	1	2	2	..	..	..	..	1	1	..	..
Total in U. S.	5982	5898	+84	4397	4325	1263	1218	1901	1941	3163	3159	242	249	409	390	2169	2039	185	143
CANADA																			
Alberta	17	16	+ 1	16	14	1	2	15	12	16	14	..	1	3	4	11	11	1	3
British Columbia	33	27	+ 6	30	26	1	1	24	23	25	24	2	..	3	..	11	15	3	..
Manitoba	16	16	..	13	12	1	3	7	6	8	9	..	..	1	2	7	3	1	2
New Brunswick	19	21	— 2	17	18	2	2	15	13	17	15	..	..	1	..	9	11	..	..
New Foundland	2	1	+ 1	2	1	..	..	1	..	1	..	..	..	..	..	1	..	..	..
Nova Scotia	30	34	— 4	30	30	..	2	22	24	22	26	1	1	2	4	10	9	..	..
Ontario	310	319	— 9	259	263	38	40	125	116	163	156	17	13	13	13	100	100	9	7
Prince Edward Island	2	2	..	2	2	..	..	2	2	2	2	..	..	..	..	1	1	..	..
Quebec	100	102	— 2	87	88	10	12	50	47	60	59	5	4	16	13	39	37	6	5
Saschatchewan	5	7	— 2	5	7	..	..	5	7	5	7	..	..	1	..	4	4	1	1
St. Pierre Et Miquelon	..	1	..	..	1	..	..	..	1	..	1	1	..	..	..	..	..	..	..
Total in Canada	534	546	—12	460	462	53	62	266	251	319	313	25	19	40	36	194	191	21	18
Total in U. S. and Canada	6516	6444	+72	4857	4787	1316	1280	2167	2192	3482	3472	267	268	449	426	2363	2230	206	161

per cent in two years. In the United States the growth has been from 143 to 185, a difference of 42 or over 29 per cent; while in Canada 21 electric steel foundries now are in operation as compared with 18 in 1918.

An interesting commentary upon the fuel situation and the probable tendency in years to come is furnished by the statistics on electric steel foundries. It will be found that where natural gas is fast becoming unobtainable, and where oil and other fuel shipments are difficult, electric furnaces are finding greater favor. This is particularly true where cheap power is available as in those regions where hydraulic-electric development has become established. It will be noted that Pennsylvania, Ohio and West Virginia, three states which are rich in material resources, but which are finding natural gas insufficient for use in melting steel, lead in the number of electric furnace steel foundries. The prominence of Washington and California in the number of electric furnace steel plants is indicative of the utility of this type equipment where water power is available.

Pennsylvania still is far in the lead among the states in the total number with 803 foundries, although there are three less than were noted in 1918. Ohio is second with 688; New York third with 582; Illinois fourth with 484, a decrease of seven; Michigan is fifth with 388, an increase of 45; Wisconsin sixth with 307, an increase of 17; and Massachusetts seventh with 263, a loss of 12. It will be noted that those states which have had the lead in the production of castings for the automotive trade have registered gains in the past two years, while those which have been mainly noted for machinery castings, and a wide variety of miscellaneous supplies have dropped away slightly. The largest gain among the leading states was shown by Michigan which now has 45 more shops than were listed in 1918. This is an increase of 12.5 per cent in two years. Ohio also has gained 32 foundries or 4.8 per cent in the period. Wisconsin, which has been favored in the location of automobile and tractor plants has gained 17 or 5.9 per cent mainly from the same source.

Ontario still is the leading foundry province of the Dominion with 310 out of the 534 shops of Canada. Quebec is second with an even 100; while British Columbia again has gained and now possesses 33 foundries as compared with 27 in 1918.

The gray iron foundry order among the states is practically the same as was noted in the reference to the total of shops listed. Pennsylvania still leads but with 606 as compared with 614 in 1918; Ohio is second with 464 as compared with 434 in 1918, showing a gain of 30 plants or an increase of 6.9 per cent. New York is third with 399 as compared with 382, an increase of 17 or 4.5 per cent; Michigan is fifth with 253 as compared with 232 in 1918, giving a gain of 21 or 9.1 per cent.

Likewise in Canada, Ontario leads with 259 gray iron shops; Quebec is second with 87; and British Columbia, third with 30 foundries making this class of castings.

TABLE IV
Leading Foundry Centers of the United States and Canada

	Total foundries 1920	Total foundries 1918
Chicago	194	188
New York	125	125
Cleveland	123	115
Detroit	122	111
Philadelphia	100	111
Milwaukee	92	94
Pittsburgh	73	76
Boston	70	71
St. Louis	68	59
Buffalo	66	64
Cincinnati	61	63
Toronto, Canada	53	49
Los Angeles	48	39
San Francisco	42	40
Newark, N. J.	39	48
Baltimore	39	41
Dayton	38	36
Toledo	38	33
Columbus	37	36
Minneapolis	37	36
Indianapolis	35	37
Seattle	31	31
Louisville, Ky	31	29
Erie, Pa.	30	33
Birmingham	30	25
Montreal, Canada	29	32
Rochester	29	30
Canton, O.	29	28
Syracuse	28	22
Chattanooga	28	22
Springfield, O.	26	24
Denver, Colo.	26	24
Reading	26	23
Portland, Oreg.	26	22
Bridgeport, Conn.	25	26
Atlanta	25	22
Grand Rapids	24	23
Jersey City	23	26
Kansas City	22	23
Worcester, Mass.	22	23
Providence, R. I.	22	21
Racine, Wis.	20	19
Hamilton, Ont.	19	21
Akron, O.	19	16
Rockford, Ill.	18	19
Quincy, Ill.	17	20
Anniston, Ala.	17	13
Vancouver, B. C.	17	10
Scranton, Pa.	16	15
Oakland, Cal.	16	17
Waterloo, Iowa	16	16
St. Paul	15	17
New Haven, Conn.	15	16
Lancaster, Pa.	15	15
Waterbury, Conn.	15	12

The total number of brass foundries reporting again is greater, there being 3163 shops in the United States as compared with 3159 in 1918. The gain has been in the exclusive brass foundries which now total 1263 as compared with 1218 in 1918. There are fewer brass foundries which are operated as departments of other shops, the total now being 1901 as compared with 1941 in 1918. The order of the states in the brass foundry industry is slightly different from that noted in the total number of foundries in the gray iron shops. Pennsylvania leads with 352; New York is second with 331; Ohio is third with 299; and Illinois fourth with 210.

The foundries melting aluminum have increased from 2039 to 2169, an increase of 130 shops or 6.4 per cent. The states rank the same in aluminum casting production as in the brass foundry listing. Pennsylvania leads with 229 as compared with 212 in 1918; New York is second with 203 as compared with 212; Ohio is third with 193 as compared with 192, and Illinois is fourth with 179 as compared with 155, an increase of 24 or 15.5 per cent. Canada now has 194 aluminum casting plants as compared with 191 in 1918.

In steel castings plants, Pennsylvania retains the lead with 100 plants as compared with 86 in 1918, thus making a gain of 14 or 16.3 per cent. Ohio is second with 52 as compared with 47 in 1918; New York is third with 28 as against 20 in 1918, and Illinois is fourth with 26 as compared with 38 in 1918. The decrease in the number of steel foundries listed in Illinois is a reflection of the tendency to consolidation and the reduction incident to after the war adjustment. Wisconsin is a close fifth with 25 steel shops as compared with the same number in 1918.

Ohio leads the states in the number of malleable plants in operation. At the present time there are 42 malleable foundries in Ohio as compared with 36 in 1918. Illinois again is second with 31 as compared with 34 in 1918; New York has passed Pennsylvania in third place, and now shows 29 shops as compared with 30 in 1918, while Pennsylvania, which is fourth, has dropped from 32 to 24. Wisconsin is fifth with 20; while Indiana and Michigan again are tied, each having 17 shops as compared with 16 in 1918; Connecticut is seventh, having only 14 plants as compared with 17 in 1918.

The ranking importance of the cities in the number of casting plants remains the same among the three leaders with Chicago first listing 194 shops as compared with 188 in 1918; New York second with 125 in both surveys; Cleveland third with 123 as compared with 115. In the fourth place, Detroit has outstripped Philadelphia with which Michigan's leading city was tied in 1918. Detroit at this time has a total of 122 shops as compared with 111 in 1918, while Philadelphia has 100 instead of 111 as shown two years ago. Milwaukee again is sixth with 92 foundries as compared with 94 in 1918; Pittsburgh is seventh with 73 as compared with 76; Boston has come up the list from eleventh to eighth place, due to including the smaller suburbs which in the previ-

ous classification were not regarded as being connected with the city. For this reason, Greater Boston in 1918 would have been credited with 71 foundries and today with 70. St. Louis is ninth with 68 shops as compared with 59 in 1918; Buffalo is tenth with 66 foundries as compared with 64 in 1918. The ranking importance of other centers in order of the number of foundries which they possess including 15 or more shops is shown in Table IV.

British Research Association is Formed

THE British Gray and Malleable Cast Iron Research association was successfully inaugurated at a national meeting held at the Queen's Hotel, Birmingham, on Thursday, Sept. 30th. The preliminary arrangements have been in progress for several months on the initiative of the Institution of British Foundrymen in co-operation with the government department for scientific and industrial research.

Matthew Riddell, president of the institution of British Foundrymen who presided at the initial meeting pointed out that the scientific aspects of iron casting have been much neglected, and there is no completely formulated body of science connected with it, possibly because ironfounders as a body were proverbially conservative. While they admit the advantages of science in the abstract, it is difficult to get them to make practical application of science.

Sir Frank Heath, K. C. B., representing the Government department of scientific and industrial research, gave the principal reasons for the establishment of the association. The trade has felt the competition from America where a research association already is yielding most promising results. It is claimed he stated that Americans can make malleable castings, exceeding by 50 per cent in tensile strength the best possible in England. During his ten days stay in Birmingham a manufacturer of pumps told the speaker that if he could only get gray iron castings free from corrosion by salt water, he could substitute iron castings for bronze in marine construction, and so save an enormous amount of money to the navy and merchant marine. Obviously in an industry with so many small firms, co-operative research is desirable and it really is an insurance against the evil effects of ignorance, and the technical information obtained would be at the disposal of every firm in the association. With nearly 3000 firms in the foundry trade, the expenditure would be trifling.

Dealing next with the financial aspect, Sir Frank said it was proposed that firms should make a subscription for a period of years, and the government had decided that results in research were not to be looked for under five years. By that time they probably would know whether the association was likely to succeed. It also was suggested that the scale of contributions should be in proportion to the size of the firm. As the government was making a contribution, it fixed a minimum, and in view of the importance of the association, they considered the total income should not be less than £5000 a year, inclusive of the government contribution. Subsequently, the government would want to negotiate on the subject of further aid to the association on the basis of giving pound for pound. Such an association should spend £50,000 a year, but the government could not go on aiding it up to any amount in the same proportion. Of the £1,000,000 set aside for research, there would shortly be only £200,000 left, and there were still other industries waiting for assistance. The government, therefore, proposed to give a contribution at the rate of pound for pound up to £25,000, making the income £5000 a year. The government aid would not be guaranteed for longer than five years. By that time, if it is not a success the manufacturers will want to get out of it, and if it is a success the firms would want it absolutely in their own hands.

The association, the speaker said, would be a limited liabilty company, distributing its profit purely in the form of knowledge and money made would go to the research fund. It is necessary to give attention also to the encouragement of university and technical training. The government will interfere as little as possible, its policy being to let the association work out its own salvation, though they will ask for information as to results, partly with a view to avoid overlapping.

Dr. L. Aitchison, in moving the establishment of the research association, mentioned that in America the malleable iron industry alone produces 1,250,000 tons per annum, while in Great Britain the rate of production in 1917 was only 76,000 tons per annum, and he was assured that the marked increase in output in America is due to the research work upon fundamentals. Apart from the work of Professor Turner, cast iron has been seriously neglected by industrial and metallurgical scientists.

F. J. Cook, seconding the motion, pointed out the great good that has been done by research associations in connection with diesel engines. The results of the American association, which has not yet been in existence five years, are marvellous, leading to great improvements in practice. Each member sends in his quota of test bars, and if these are up to a certain specification a certificate is given to the firm, which is accepted by engineers generally as a guarantee of that firm's products for the next six months. If the test bars of a firm do not come up to specification, the whole matter is gone into, and generally the association puts that firm right in a short time.

The resolution in favor of the formation of the association was unanimously carried. Professor Turner indicated several lines on which research is called for, such as the structure of the chemical composition of pig-iron, pouring temperatures, rate of cooling, impurities, pressure during casting and blast pressure, etc.

The following are the officers of the association: President, Lord Weir; vice presidents: Douglas Vickers M. P., Sheffield; Vice Admiral Sir George Goodwin K. C. B., President of the Institute of Metals; Sir James McKechnie, Barrow Hematite Steel Co.; W. Petters, Yeovil; A. A. Lang C. B. E., Wallsend; Dr. J. E. Stead, President of the Iron and Steel Institute; Sir Charles Wright, Baldwins, Ltd.; F. E. Robbock, Harland & Wolff, Belfast.

The provisional committee appointed H. J. Yates chairman, and H. B. Weeks and F. J. Cook vice chairmen of the council. T. Vickers, who made the preliminary arrangements has been appointed secretary. A meeting of the council was held at the Queen's Hotel, Birmingham, on October 14th, on which occasion Lord Weir presided.

Talks On Americanism

With the subject off "Americanism as it applies to Industry" Rev. David Fraser, of Somerville, Mass., addressed the New England Foundrymen's association at a meeting held at the Exchange Club, Boston, Wednesday Oct. 13. A. B. Root, Jr. president of the association, discussed the question of educating of foreign workers as an excellent means of avoiding labor difficulties. It seemed to be the consensus of opinion that this subject is a live one at the present time and worthy of the deepest consideration.

Heat Treatment Improves Castings

Strength and Elongation of Cast-Steel Tractor Parts Are Improved by Quench-and-Draw Treatment—Danger From Hardening Cracks Eliminated by Removing Castings From Water Before Entirely Cool

BY FRED GROTTS

HEAT treatment of steel castings has been developed to such an extent that where formerly parts were made of forgings and cold rolled steel, now treated castings can be substituted at a reduction of cost and with satisfactory results.

Annealing was at one time considered the only treatment applicable to castings. It consisted in heating the material to above the upper critical point and holding it there for varying lengths of time, according to the kind and quality, then cooling slowly. This procedure was intended to break up the original austenitic condition, which is brittle and hard, into a mixture of ferrite and pearlite which resists shock and is soft.

Inability to obtain forgings and unsatisfactory results from annealed castings gave rise to intensive research on the advisability of heat treating castings of different analyses. With this idea in view, low, medium and high carbon steel castings as well as chrome-vanadium, chrome-tungsten, chrome-nickel and manganese steel castings were obtained and tested with gratifying results in each case.

Low carbon castings as shown in Fig. 1, containing: Carbon, 0.18 to 0.22 per cent; manganese, 0.55 to 0.65 per cent; sulphur, 0.05 to 0.06 per cent; and phosphorus, 0.04 to 0.07 per cent, after annealing at 1650 degrees Fahr., had a tensile strength of 65,500 pounds per square inch, a yield point of 33,900 pounds per square inch elongation of 21 per cent and scleroscope hardness of 24. The fracture was coarse and crystalline. After heating to 1600 or 1625 degrees Fahr. and quenching in water they had the following properties: Ultimate tensile strength, 76,800 pounds per square inch; yield point, 47,900 pounds per square inch; elongation, 16 per cent and scleroscope number 30. In some cases it was necessary to fabricate parts that were shock resisting in some sections and hard for a bearing surface in others; for example, the pintle latch, Fig. 1, is made of low-carbon steel to work or turn on a case-hardened bolt. Accordingly, the surface in contact with the hard bolt was carbonized and quenched, the hardness being scleroscope number 75, while the remainder of the part was allowed to cool slowly to a scleroscope hardness of 35 to 45.

Gears from cast steel were tried out in several different places with good success. There was some trouble from shrink cavities in thick sections but these were controlled by correcting the foundry practice. Some of these gears, however, were in the annealed state. The casting shown in Fig. 3 is a low-carbon cast-steel gear containing 0.20 per cent carbon, which always had been case hardened. It was packed in carbonizing material for about eight hours at a temperautre of 1700 degrees Fahr., then cooled and reheated to 1625 degrees, quenched in oil, again quenched from 1450 degrees in water and then drawn to a scleroscope hardness of 75.

The medium carbon steel is best illustrated in he track shoe, Fig. 5. This part weighs about 50 pounds, has irregular sections and is subject to great stress and wear. In the annealed state some difficulty was experiencced because of softness and irregularities in the structure. To properly anneal

Paper prepared for the convention of the American Foundrymen's association held at Columbus, O., Oct. 4 to 8, by Fred Grott, Holt Mfg. Co., Peoria, Ill.

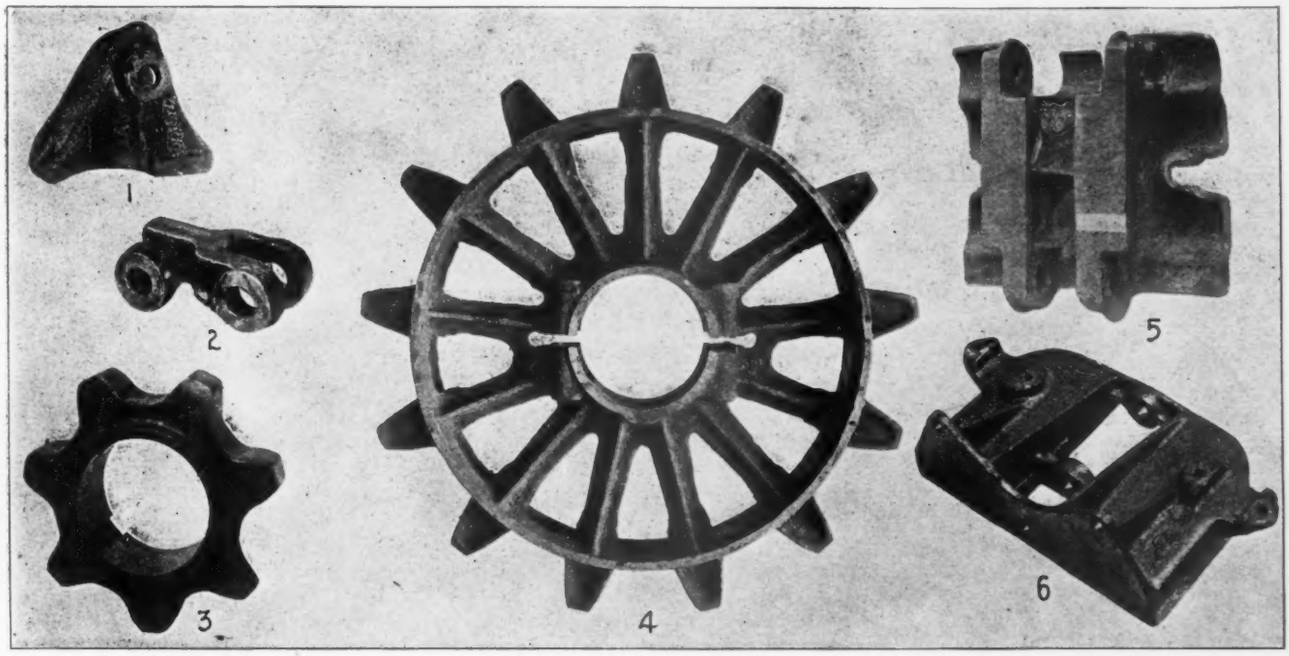


FIG. 1—PINTLE LATCH CASE HARDENED AROUND HOLE GIVING SCLEROSCOPE HARDNESS OF 75 TO 85 FIG. 2—CLUTCH LINK FORMERLY LOW CARBON FORGING—QUENCHED AT 1500 AND DRAWN AT 1000 DEGREES FAHR. FIG. 3—CASE HARDENED GEAR, HARDNESS, 75 TO 85 FIG. 4—CAST STEEL DRIVE SPROCKET QUENCHED AT 1600-1625 DEGREES AND DRAWN AT 1050 GIVING A SCLEROSCOPE HARDNESS OF 40 TO 45 FIG. 5—TRACK LINK QUENCHED IN WATER AT 1500 DEGREES AND DRAWN AT 1050 DEGREES, SCLEROSCOPE HARDNESS. 35 TO 45 FIG. 6—BRACKET; CARBON 0.30 TO 0.40 PER CENT—QUENCHED AND DRAWN—HARDNESS, 30 TO 40

FIG. 7—CHROME-TUNGSTEN CASTING AS RECEIVED FROM FOUNDRY MAGNIFIED 50 DIAMETERS

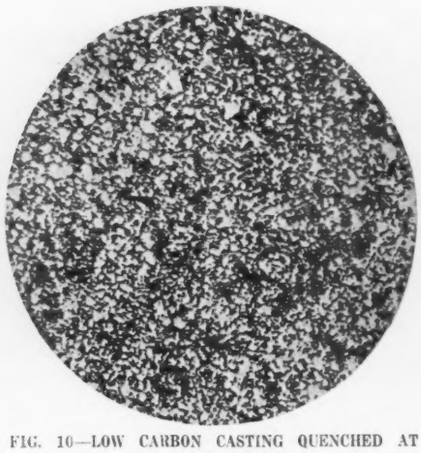


FIG. 10—LOW CARBON CASTING QUENCHED AT 1600 TO 1625 AND DRAWN AT 1050 DEGREES

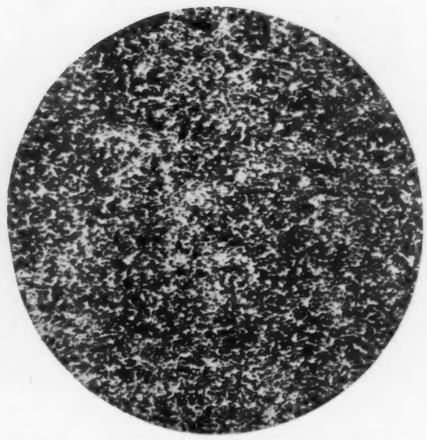


FIG. 12—MEDIUM CARBON CASTING QUENCHED AT 1500, AND DRAWN AT 1050 DEGREES. FROM CASTING SHOWN, FIG. 4

these castings, a higher temperature than that used for annealing forgings and bar stock is necessary owing to the castings not having the benefit of

FIG. 8—CHROME-TUNGSTEN QUENCHED AT 1550, DRAWN AT 1100 DEGREES, HARDNESS, 45 TO 50

the rolling or forging operations. Steel having an average analysis of carbon 0.35 to 0.40 per cent when annealed at 1550 degrees Fahr. had a tensile strength of 85,000 to 90,000 pounds per square inch, a yield point of from 65,000 to 75,000 pounds per square inch an elongation of 18 per cent and a scleroscope hardness of from 25 to 32.

The best properties were obtained by quenching in water at 1500 Fahr. degrees and drawing 1050 degrees. Care was observed in quenching as there was some danger of hardening cracks. This was easily controlled by removing the castings from the water while they were still hot (500 to 700 degrees Fahr.) The amount of distortion was very slight and caused no interference in assembly. The structure after drawing was sorbitic which is tough and strong with an ultimate tensile strength, 115,000 pounds per square inch; yield point, 80,000 pounds per square inch; elongation, 12 per cent; and a scleroscope hardness of from 40 to 50.

The castings having from 0.50 to 0.55 per cent carbon were not as satisfactory as the lower carbon steel.

Alloy steel castings gave somewhat superior results to the carbon steel. The analyses and heat treatment of alloy castings follow:

Chrome-Tungsten		Chrome Vanadium
Carbon	.43	.22
Manganese	.53	.51
Sulphur	.048	.045
Phosphorus	.037	.042
Chromium	.95	.47
Nickel	Trace	Trace
Vanadium	None	.12
Tungsten	.49	None
Annealed at	1575 to 1625	Annealed to 1625 to 1650
Tensile	110,000	92,000
Yield	85,000	75,000
Elongation 10 per cent		22 per cent
Scleroscope	30	28

FIG. 13—HIGH CARBON CASTING QUENCHED AT 1475 AND DRAWN AT 1050 DEGREES. SORBITE. HARDNESS, 50 TO 60

Quenched at 1550 degrees	Quenched at 1625 degrees
Draw at 1100 degrees	Draw at 1050 degrees
Tensile 130,000	105,000
Yield Point 112,000	88,000
Elongation 6 per cent	14 per cent
Scleroscope 47	35

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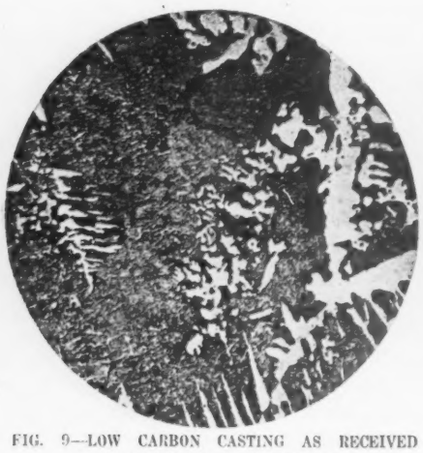


FIG. 9—LOW CARBON CASTING AS RECEIVED FROM FOUNDRY. MAGNIFIED 50 DIAMETERS

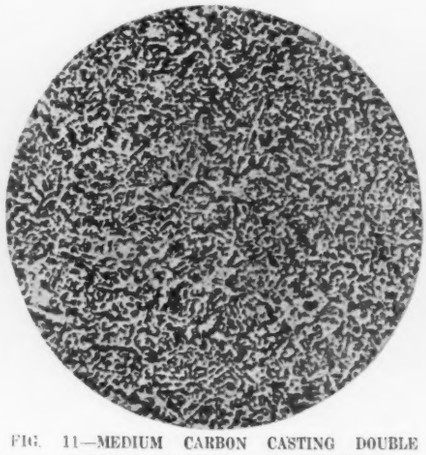
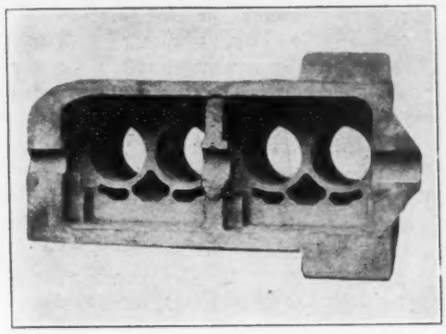


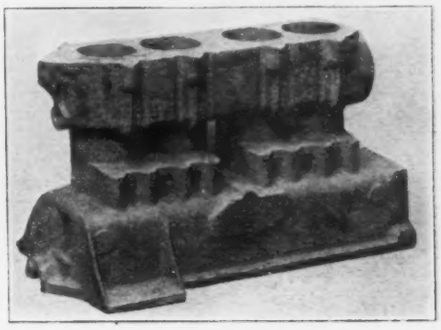
FIG. 11—MEDIUM CARBON CASTING DOUBLE ANNEALED, PEARLITE AND FERRITE. SCLEROSCOPE HARDNESS, 25 TO 28

FIG. 14—MANGANESE STEEL CASTING ANNEALED AT 1950 DEGREES. AUSTENITE, HARDNESS, 35

Cylinder Cores Made In Green Sand



Special Machines for Cores and Molds Together with Accurately Fitting Flasks and Arbors are Outstanding Features of the Process



COVERING a number of years and receiving its greatest impetus with the World War, the design and development of automatic machinery for production work in the foundry industry has received marked attention. With the beginning of the war enormous demand for castings of every description revealed that the sources of supply were wholly inadequate to meet the need. The requirements and specification for government work called for greater accuracy than ever had been required in rough castings up to that time. That such accuracy could not be obtained by old-fashioned methods was evident. As a result tremendous strides have been made and production foundries today are using equipment of a nature that none of the designers would have dared predict ten years ago. The war need led to the specializing of machines for certain classes of production and this tendency in design has been reflected more particularly in machines for foundries producing automobile cylinders and kindred parts. However, the height of production in the automobile cylinder class did not really reach a peak until nearly a year after the signing of the armistice and special endeavor along this line still is being made by manufacturers of molding appliances.

This article describes the development of one of the newer types of machines which has just been announced by John T. Stoney, foundry manager of the Ferro Machine & Foundry Co. of Cleveland, O. Patents have been granted on the basic principles involved in the design of these machines.

It is needless to review the development of molding machine designs except for the purpose of comparison of methods. The simplest and earliest design was that of the squeezer type and its development led next to the stripping plate, then to the bumping machines and later to the roll-over type. A majority of the designs up to the time of this new development of Mr. Stoney's have

The material for this article and a number of the illustrations are provided through the courtesy of E. W. Beach, general manager of the Ferro Machine & Foundry Co.

FIG. 1—GENERAL ARRANGEMENT OF MOLDING AND COREMAKING MACHINES, SAND HOPPERS, MONORAILS AND MOLD CONVEYOR

FIG. 2—THE MACHINE REVOLVES HORIZONTALLY—WHILE TWO COPES ARE BEING RAMMED ON ONE SIDE, THE FINISHED MOLDS ARE BEING LIFTED OFF THE OTHER SIDE AND EMPTY FLASKS SET IN THEIR PLACE

been either on the straight lift and trunion roll-over or that of the roll-over arm movement from front to back. Mr. Stoney's ideas are predicated on the basis that speed of the completed molding operation is accelerated where more men may be employed upon the work or at least in handling the molds in successive operations and that this can be accomplished best by a horizontal circular movement in a continuous direction rather than in the shuttle movement of forward and back.

Dry Sand Cores Eliminated

The original machine of this character designed about two years ago and exhibited at the American Foundrymen's convention held in Philadelphia, contained the germ of the idea and possessed the fundamental principles which now have been developed. In considering the problem of producing molds in quantity without detriment to the quality of the casting turned out, it occurred to the designer that the problem of an ample supply of cores was being neglected and that, after all, only a small reduction in cost of castings was gained if core production cost was not correspondingly reduced and core production speed increased. This particularly is true in automobile cylinder work where cores form a major portion of the total cost. With this idea in mind, he turned his attention to the manufacture of green sand cores by means of semi-automatic machines on which intricately cored casting might be completed on the foundry floor without recourse to a core department. The problem resolved itself into one of designing suitable arbors of a collapsible nature which could be provided at a reasonable cost and of a sufficiently rugged design to stand repeated use.

The floor space occupied by the equipment here described is 34 feet by 120 feet; or a trifle over 4000 square feet and the equipment is designed for the production of the Chevrolet cylinder casting. This casting is of the open-head type and is cast four *en-bloc* with an integral crank case.

The cylinder previously had been run as a production job on the regular cylinder molding floors of the Ferro Foundry at a rate of 220 cylinders a day, occupying approximately 5600 square feet. The new equipment, it is stated will produce 500 cylinders per eight-hour day or a little more than twice the tonnage per square foot of foundry floor space. In other words, figuring this cylinder at 115 pounds, the production of this equipment will be approximately 30 tons per day. In the production of these 500 castings another favorable comparison entering into the production cost is that it required 36 men to produce all the cores and molds up to the point of pouring for 220 as against 12 men to produce 500 castings by the new method. The substitution of green sand for dry sand relieves the core department of 26 tons of cores per day on the basis of 500 castings. The green sand from the cores passes through the same regeneration plant as the molding sand.

Sequence of Operation

The conveyor system for handling the molding sand from the mixers to the molding machines and also the conveyor for carrying the finished molds to the pouring zone and then onto the shake-out grating is a standard type. A general view of this equipment from a position opposite the knockout is shown in Fig. 1. The machine in the foreground is a jolt, squeeze, stripping machine for making

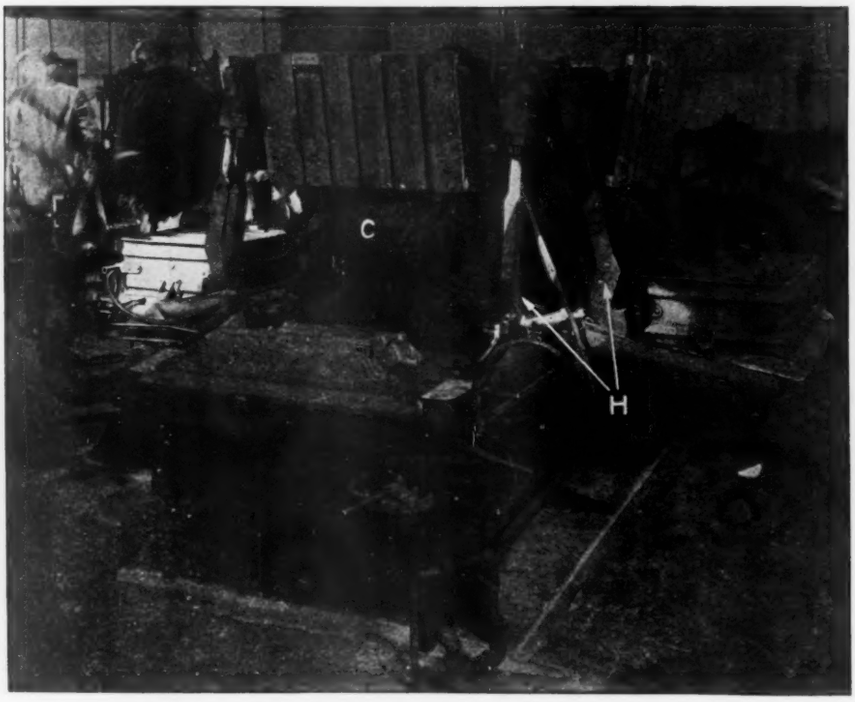


FIG. 3—DETAILS OF RAMMING TABLE, AIR CONTROL VALVES AND SQUEEZING MECHANISM

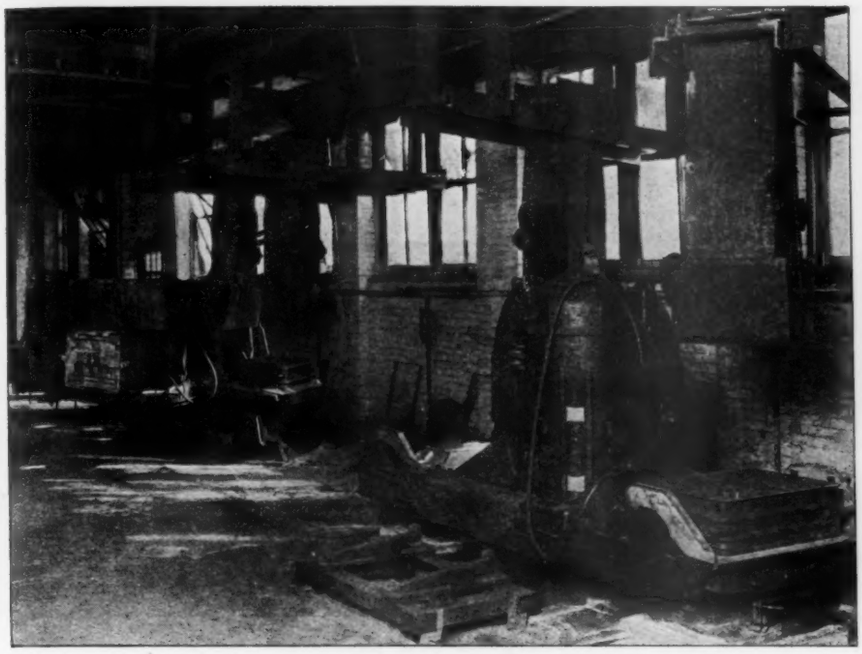


FIG. 4—THE DRAG MACHINE IS EQUIPPED TO HANDLE TWO FLASKS AT ONE TIME

the copes. The second machine in the line is a jolt, roll-over machine for producing the drags. Two cylindrical machines at the end of the line are the revolving, hand-ram, roll-over core machines. The method of producing a completed mold is as follows:

On each side of the drag machine which is second in the line noted in Fig. 1, is a narrow gage track running from this machine to the core machines. The first operation is to produce two half molds on the drag machine and roll them over. The machine is then turned 90 degrees and lowered so that the mold rests on cars, the clamps released and the patterns drawn the machine then being turned to its original position. The drag half of the dry sand jacket core is placed in position and the two drags are then pushed forward on the trucks to a registered position alongside and in front of the core machine.

The cope part of the crank case and barrel cores, which are integral, are made in green sand at the back of the machine and the drag half, which contains the arbor, is made in the front. On the completion of these two halves the drag half of the corebox is revolved to a position over the cope half and lowered upon it. The arbor is then released from the drag half of the corebox and clamped to the cope half. The drag half of the corebox is placed back in its original position to receive another arbor and repeat in the making of the drag half. The supporting arms for the core machine are then revolved and placed in position on the trunnions of the cope half, the cope rolled over and turned 90 degress to position over the drag half of the mold and is lowered onto the registering pins of this portion of the mold. The arbor is then released from the cope half of the corebox, and the corebox is drawn and returned to its original position for repeating the operation of coremaking.

The drag with the core set is then placed on the conveyor by a light chain hoist trolley. As the conveyor is the plate type and the progress of the mold is not dependent on the engaging of dogs on the same, the drag may be placed at any position irrespective of regular intervals. The drag then proceeds on the conveyor to a point opposite the cope machine, in the meantime receiving the upper portion of the jacket core which has been adjusted and pasted to the lower half. The mold receives the cope at this point and ample time is given for clamping and placing runner boxes before arriving at the pouring zone. Iron is delivered by overhead trolley ladles and a space of some 30 feet is used for pouring. The mold then is carried to the end of the line where it is automatically pushed off onto the knockout grating by the succeeding molds in the line. The castings are removed and placed on suitable trucks for removal to the cleaning department. The sand passes through the knockout grating to the conveying belt in the cellar and thence to the sand regenerating plant for recutting. At present the drag and cope halves of the flask are returned to position opposite the machines by light trucks but a roller conveyor is being considered. The advantage to be gained by the type of machine which makes the cope is from the fact that two copes are made by the same mechanical operations while at the same time laborers are placing two empty copes on the stripping plates, which, when the rammed copes are completed, are revolved to a position over the pattern and lowered

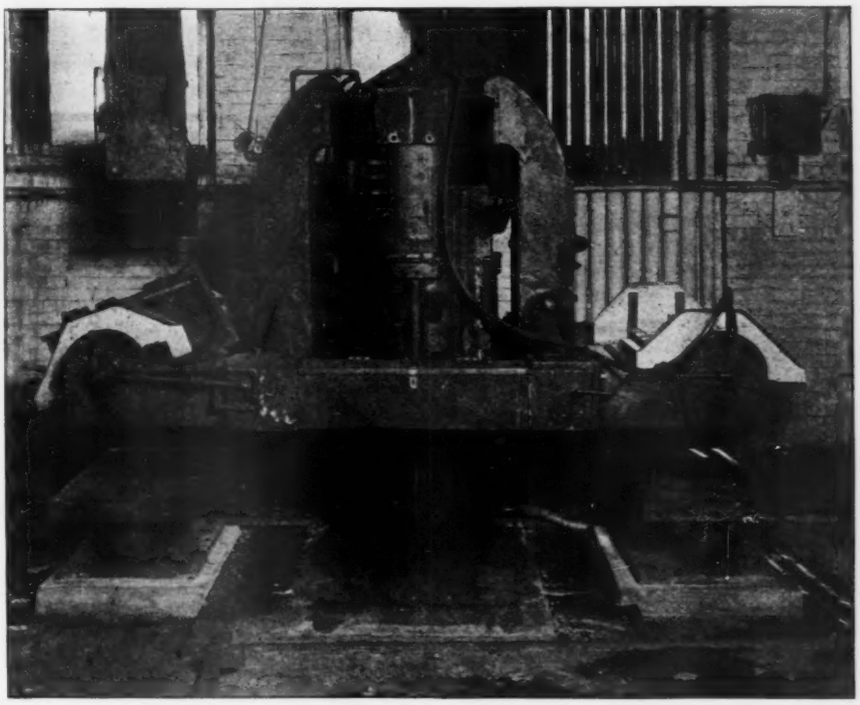


FIG. 5—THE CYLINDER IN THE CENTER SLIDES UP AND DOWN CARRYING WITH IT THE TURRET HEAD TO WHICH THE PENDANT ARMS ARE ATTACHED

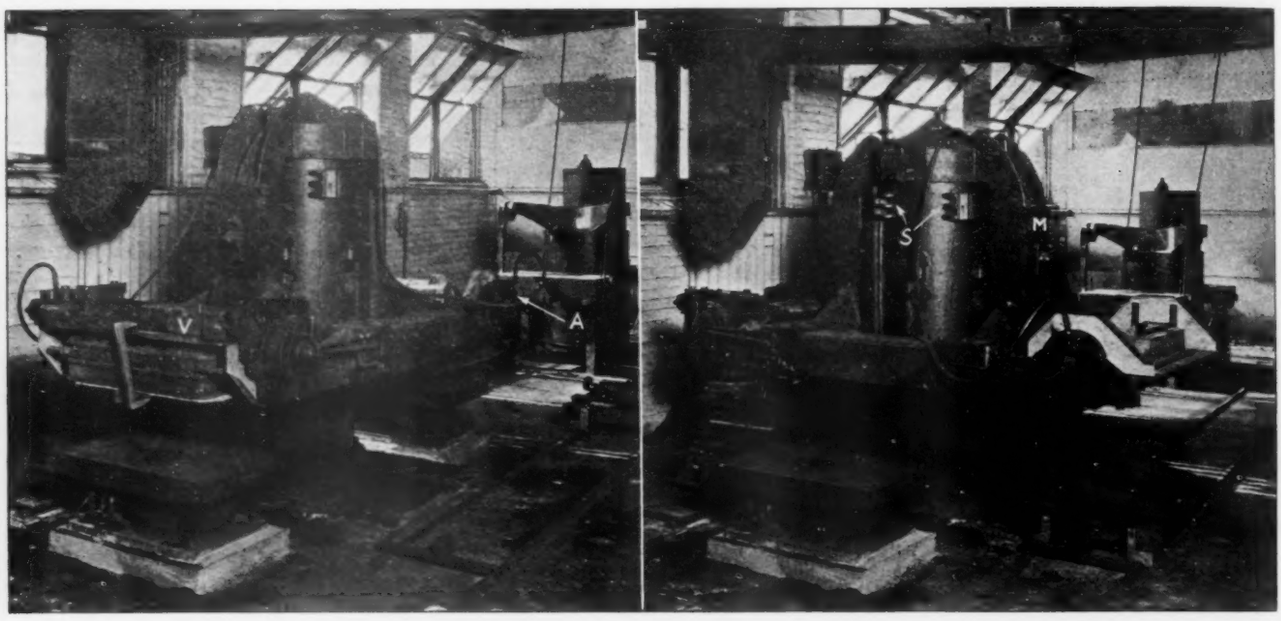


FIG. 6—AFTER THE FRAME OF THE MACHINE HAS BEEN RAISED, THE FLASKS ARE ROLLED OVER FIG. 7—THEY THEN ARE LOWERED UPON TRUCKS PROVIDED WITH ADJUSTABLE LEVELING DEVICES

while the laborers remove the completed copes and again place empty flasks on the stripping plates.

The foregoing may be regarded as a general description of the installation and the methods by which it functions. The construction of each machine and the rigging and equipment employed for handling the molds and cores will now be considered.

The cope making machine shown in the left foreground in Fig. 1 and from two other positions in Fig. 2, 3 and 4 is a combined jolt, squeeze and stripping plate machine equipped to handle four flasks at one time. Four sets of arms attached to a revolving turret head are provided at the lower extremities with stripping plates. Two jar-ram tables and cylinders are located on the side of the machine near the wall. The cope patterns are attached to these tables and in the event that it becomes necessary to change jobs it is relatively simple to detach the patterns, substitute others and attach corresponding stripping plates.

The jolting tables may be operated independently but when the flasks are rammed a valve under the control of one man is employed to lift the turret head which in turn brings up the four sets of arms carrying the stripping plates and the copes. The method of revolving the machine and substituting empty for full flasks on the jarring part of the mechanism has already been described.

Details of Operation

After the mold has been jar-rammed sufficiently the squeezing head is lowered until it rests on the sand. The hooks, two of which are indicated at *H* Fig. 3, slip down until they engage anchor pins attached to the base casting. They are guided into place and locked by an air operated pine shown at *P* Fig. 1. To release the hooks after the mold has been squeezed, air is admitted to a cylinder operating an arm and crank in the case *C* Fig. 3. At the same time a small pin plunger throws the hooks out of engagement with the anchor pin, the crank arm with a throw of 180 degrees pulls the hook back and the squeezing head up out of the way.

The drag machine is similar to the cope machine in its construction and method of operation with the exception that it is only equipped with two sets of arms. The squeezing heads also are omitted and instead mechanism has been provided to roll the flasks over. Adjustabe stops shown at *S* Fig. 6 are provided to regulate the arc of travel. The cope machine swings in an arc of 180 degrees; but the drag machine is confined to 90 degrees. This stop insures that the flask will register accurately on the ramming tables and afterward on the truck which bears them to the core making machines.

Air for operating the machine exclusive of the ramming cylinders which are piped separately, is admitted through the base. An air chamber in the turret head which derives its supply of air through a telescope valve in the main cylinder, supplies air for operating a motor inside the frame at *M* Fig 6. This motor in turn transmits its energy through suitable sprockets and chains to a worm

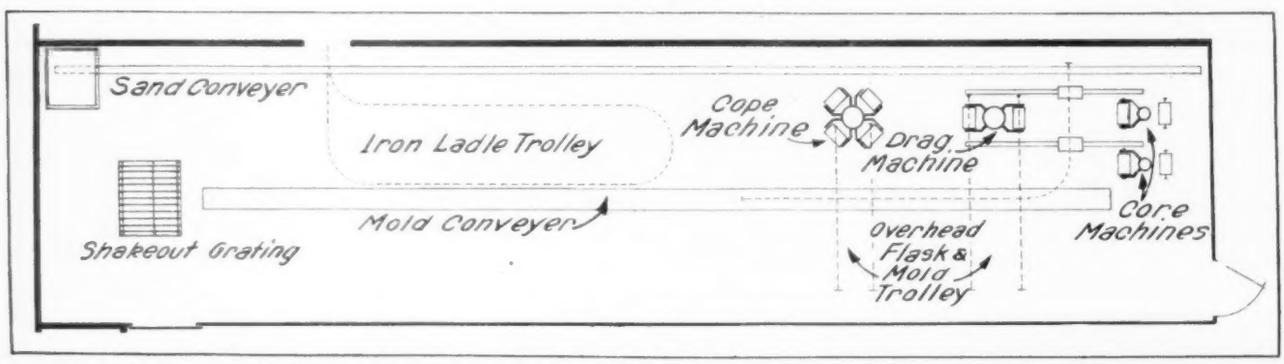


FIG. 8—GENERAL LAYOUT OF THE FLOOR AND EQUIPMENT DEVOTED TO THE PRODUCTION OF GREEN SAND CYLINDER CORES AND MOLDS

inside the casing at each end of the roll over table. The vibrator shown at *V* Fig. 7 forms an integral part of the cast steel, heavily ribbed plate on which the pattern is mounted. It is expected that this device will last indefinitely or at least as long as the pattern plate because when the vibrating mechanism wears out it simply will be necessary to remove the wornout parts and substitute a new bushing. Air for the vibrators is supplied from the turret head through

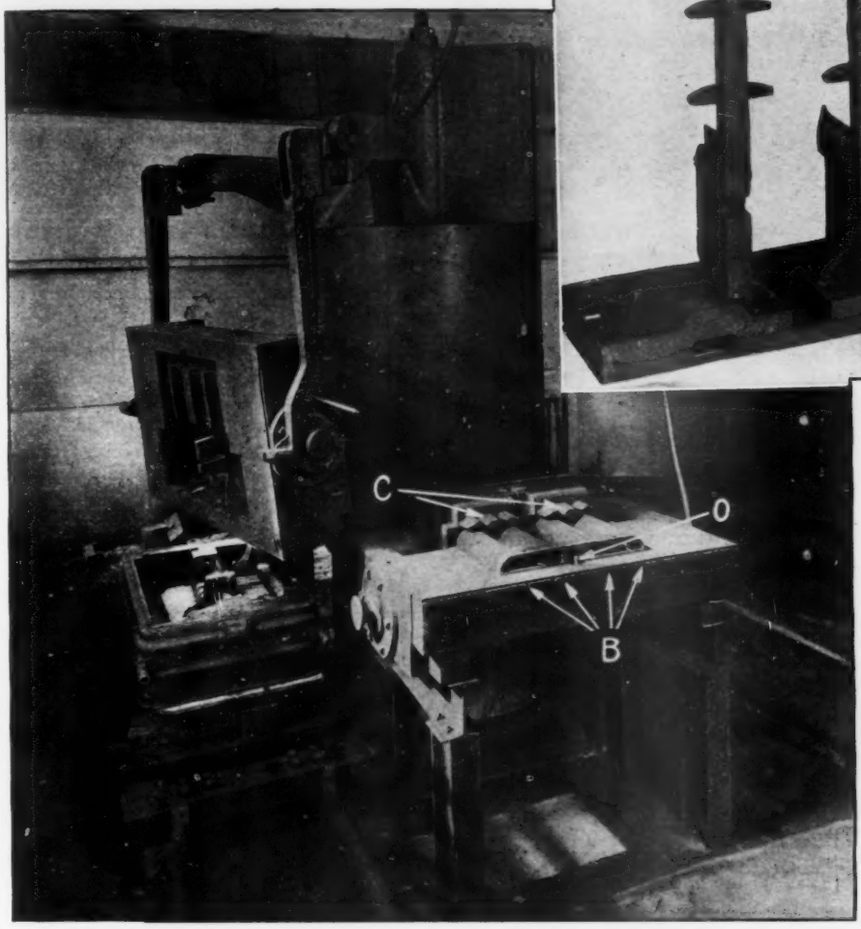


FIG. 9—THE CORE AS IT APPEARS AFTER THE DRAG HALF OF THE BOX HAS BEEN REMOVED

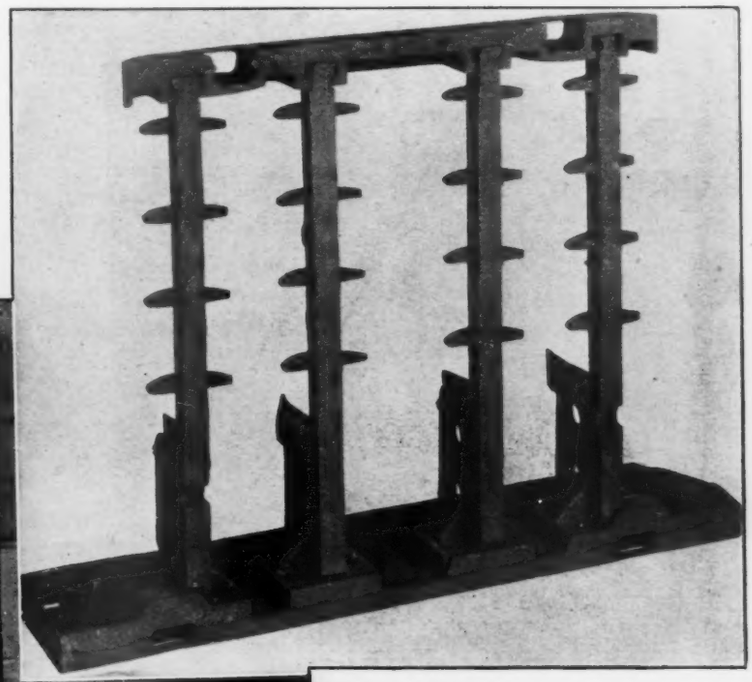


FIG. 10—ONE OF THE CORE ARBORS

short pieces of hose provided with suitable nozzles. When not in use the nozzles are stuck in suitable clips provided for that purpose one of which is indicated at *A* Fig. 7.

The lifting arms of the machine are not in contact with the pattern plate while it is resting on the ramming table. After the mold has been rammed the lifting mechanism is set in motion and the flask lifted to any predetermined height between 2 and 22 inches. Air is then admitted to the motor controlling the roll over machinery. The same motion also throws an automatic lock into position at each end of the pattern plate after it has attained a height of 15 degrees above the horizontal.

While this has been described in the singular it will be borne in mind that it is a twin machine and two molds are made simultaneously. It has been described in the singular merely for the sake of clearness. The same description applies to each side of the machine. In this machine as in the machine for ramming the copes, the ramming tables may be operated independently; but both sides lift at the same time and both patterns are drawn simultaneously.

After the molds are rammed and bottom plates clamped the lifting arms pick them up, swing around through an arc of 90 degrees and lower them onto a pair of low trucks, one on each side, provided with automatic leveling bars. The clamps are then removed, plates vibrated, patterns drawn, rolled over and returned to original position over the ramming table. The space between the arms on each side has been utilized to hold a tool box and general catchall.

The two machines shown at the extreme right of Fig. 1 are employed for making the cores; but since they are similar in every respect a description of one will answer for both. The sand in the core boxes is rammed by hand, the function of the machine is to handle the boxes lift them, turn them over, draw them off the core and lower the core into the mold with precision. Perhaps a more accurate description would be to say that the mold is lowered on to the core for that is actually what happens. The drag of the mold is inverted after the lower half of the dry sand jacket core has been set, and lowered on to the completed core from which the drag half of the corebox has been removed. They are then clamped together and rolled over after which the cope half of the box is removed leaving the drag of the mold sitting on a plate and the complete core in place.

The sequence of operations is clearly shown in Figs. 9 and 11. The coreboxes, reinforced on the joint side by ¼-inch steel plate and provided at the ends with trunnions for rolling them over are set up for ramming on I-beam stands, one on each side of the machine. The arbor shown in Fig. 10 is set in the drag half of the box. The cope side does not need any arbor.

The arbor shown in the illustration Fig. 10 is one that was used in the early trials. The longitudinal wings are bolted to the cross bar at one end and dovetailed into sockets at the other end. The arbors employed in

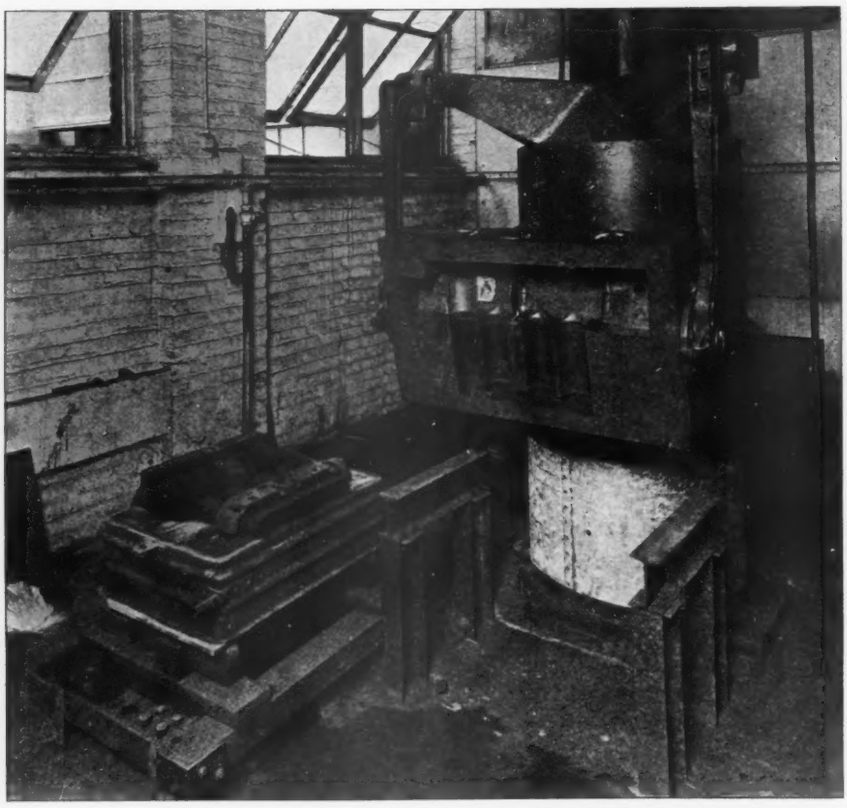


FIG. 11—THE DRAG WITH THE COMPLETE CORE IN PLACE—THE JACKET CORE, TWO LIGHTENING CORES SHOWN IN FIG. 9 AND TWO NARROW CORES FORMING THE CENTER RIB AND BEARING ARE THE ONLY DRY SAND PARTS

regular production are cast in one piece with the exception that the small end still is attached in the manner shown. It is readily apparent that after the casting has been poured and shaken out the small end of the arbor can be detached and the remaining portion drawn out of the casting.

In making the drag half of the core the arbor is set first, and clamped, then the dry sand cores indicated by *C* Fig. 9 which are held in place by keys and wedges are placed. The box is then filled with sand, rammed by hand and struck off level. The cope half of the core is rammed simultaneously. The arms of the machine are swung around to engage the trunnions on the ends of the drag corebox. Air is admitted to the cylinder and when the box has been raised high enough it is turned over, pushed around through an arc of 180 degrees and lowered on to the cope half of the box. Three clamps in the cope half of the box, one of which is shown at *O* Fig. 9 are then tightened, the clamps on the drag half released and the drag half of the box removed, leaving the core as shown in Fig. 9.

The drag half of the box is then replaced on its own stand afer which the lifting arms are brought back and attached to the cope half. This half which now holds the entire core is picked up, rolled over and swung through an arc of 90 degrees horizontally and lowered into the waiting drag mold. It is guided into place by two long pins. After it has been set the clamps holding the arbor are released and the cope half of the corebox lifted off and replaced on its own stand ready for another core.

Placing the upper half of the jacket core and the subsequent closing of the mold and pouring already have been described. The sand after being screened and tempered is returned to the machines by an endless belt discharging into a hopper placed over the space occupied by the different flasks on the machines. These hoppers are designed to hold just enough sand to fill a flask each time and by an ingenious arrangement of plows and counterweights the flow of sand into each is cut off when the desired amount is in the hopper. The individual hoppers are drawn forward to discharge the sand and then are returned to their position under the main sand delivery chute.

Cheap Runway Improvised

Many foundries have occasion to build cheap temporary, or even permanent, runways and find the cheapest construction to be wood planks. However, these do not last a long while and soon splinter. The Los Angeles Valve & Fitting Co., Los Angeles, had occasion to lay temporary runways to the dump and found that boards which they laid for the track did not last long. A new method was then tried which gives satisfaction and has a long life. The runway was made from common 2 x 6 planks and a coating of roofing pitch was spread on the surface of the planks with a brush while hot. Before the pitch cooled river sand was riddled on it through a No. 8 riddle. A layer of this sand stuck to the surface of the pitch and produced a hard surface for trucking over. So far the new runway has lasted a year with very little or no perceptible signs of wear,

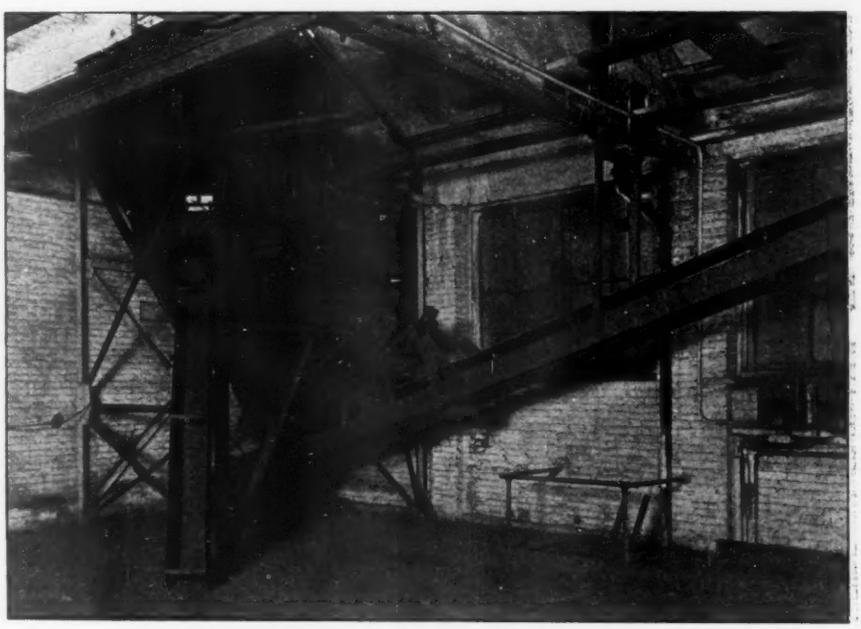


FIG. 12—END OF THE MOLD CONVEYOR, KNOCKOUT GRATING AND HOPPER WHICH SUPPLIES THE SAND FOR THE ENDLESS BELT PASSING OVER THE MOLDING MACHINES

Judging Sands for Foundry Use—III

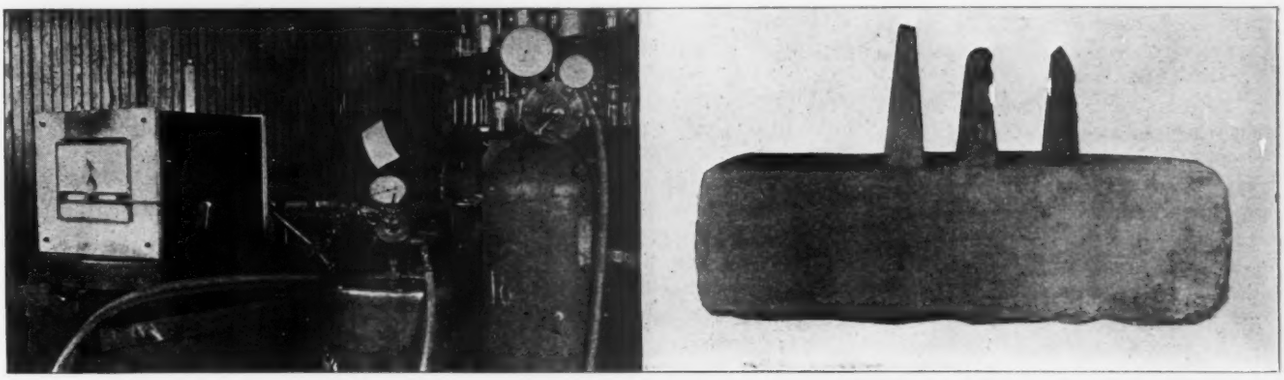
Refractory Sands Essential for Smooth Surface—This Property Limited by Fusion Point of Bonding Material—Presence of Iron Oxide Not Greatly Detrimental Unless Accompanied by Alkalies

BY HENRY B. HANLEY AND HERBERT R. SIMONDS

THE chief cause of poor surfaces on castings is the low refractory quality of the molding sand. It is therefore important to study this property in connection with molding sand. The subject is not as simple as it was at first thought. Sands ordinarily employed for molding, and which are termed natural sands, are a complex aggregate of a number of minerals containing, in some cases as many as 12 to 15 separate bases, and carrying a bond which in itself contains a variety of absorbed and easily fusible salts. One of the difficulties in experimental work to determine refractoriness of molding sands is that a single substance of high refractory quality may break down at one of several different temperatures, depending upon the ingredients with which it is mixed. To illustrate the nature of this change in melting temperature, a common example of the same phenomenon is that of ice which normally melts at 32 degrees Fahr. but which in the presence of salt melts at a lower temperature. On the other hand, it is possible to take a sand with a given refractory character and by the use of heat resisting coatings to increase its melting point for use in molding.

The presence of feldspar, as has been pointed out in a previous article, has the effect of reducing the refractory quality of the sand. A sand carrying 40 per cent of feldspar will ordinarily not stand up against hot molten iron. Such a sand may, however, be protected by a good coating of lead or blacking, and may then be used for certain classes of work without surface melting. The bond of a sand is closely associated with the sand's refractory nature and many of the same characteristics apply to refractoriness in general as apply to bonding properties. A temperature too low to break down the heat resistance of a sand may still cause a gradual deterioration which eventually means a loss of usefulness of the sand for molding purposes.

All of the tests usually employed in investigating molding sands have some bearing upon the refractory qualities. When, however, such qualities form the chief object of research work, a little different method is usually employed. The clayey bond substance is entirely separated from the sharp grains of sand and the determination of fusibility or of the point of vitrification for this clayey substance is then determined. Such a determination gives direct information concerning the melting point of the bonding substance of the sand. According to recent work it is this bond substance which is the first to fuse under the action of molten iron.



SPECIMENS OF CLAY BOND AFTER FUSION—THE SAMPLE TO THE RIGHT IS THE SEGER CONE APPARATUS USED TO TEST REFRACTORINESS OF CLAYEY BOND IN MOLDING SAND—THE FURNACE IS SHOWN AT THE LEFT

Refractoriness and Bond

At first, investigation was made with out separating the clayey substance from the molding sand, with the result that sands possessing similar sized grains containing about the same percentage of bonding substance nearly always showed approximately equal melting points. These sands were often known to have decidedly different working properties on the foundry floor and the laboratory tests were therefore known to contain some error. Later, a more exhaustive investigation led to the separation of the clay substance from the sand grains for test purposes. The results thus obtained were carefully checked up by actual practice in the foundry and showed that the refractory qualities of different sands are dependent almost entirely upon the purity of the clay substance which goes to make up the bond. Experimental work along this general line has developed the fact that there is a wide difference in the refractory qualities of the bond, and as clay substance is the most easily fusible material present, information concerning its heat resisting nature, furnishes a direct gage as to the refractoriness of the sand as a whole.

Quartz and feldspar are the materials which form the bulk of molding sands. The melting point of feldspar is 2350 degrees Fahr. while the pouring temperature of gray cast iron may be as high as 2500 degrees. From this it is seen that in a strict sense feldspar is not a refractory mineral. Quartz, the principal constituency in all sands, melts at about 2912 degrees Fahr. But this does not mean that a sand made up largely of quartz will always require a temperature of 2912 degrees Fahr. to melt it. When the sand mixture contains other minerals which are refractory, the quartz may be taken into solution at a lower temperature. Granite for instance, fuses at a temperature of 2264 degrees Fahr., though quartz is one of its principal constituents. From this it is evident that some factor aside from the melting point of the individual mineral, controls the fusion point of the

sand when considered as a whole.

As a sand is heated, the more fusible minerals become liquid first, and in this state attack the more refractory ones with the result that the melting point of the whole is lowered. The influence of the clayey constituence upon the fusibility of molding sand may be readily understood from a typical chemical analysis of the bond. In the example given, the clay must be rated as a low-grade fireclay which will not stand up against the temperature of molten iron.

Bond Analysis

	Per cent
Silica	40.15
Alumina	25.75
Iron Oxide	13.13
Lime	1.30
Magnesia	1.10
Sodium Oxide	.37
Potassium Oxide	4.10
Loss on ignition	13.70

The fluxes which bring about lower melting points in clay are the alkalies—sodium and potassium—the alkali earths—calcium and magnesium—and the iron oxide. In the table these constituents are shown to be present in large quantities and it is for this reason that the clay substance melts at a low temperature. This sample melted at a temperature of 2100 degrees Fahr, which is sufficiently low so that molding trouble will always be present if sand is used which has this bond. To correct this difficulty it is necessary to use sharp sands free from bond in the mixture, and in the sand taken for the example above, such addition of sharp sand was made with excellent success. This at the same time brought about a more open grain structure.

	Fusion Point	Average
Pennsylvania		
1	2080 degrees Fahr.	
2	2160 degrees Fahr.	
3	2100 gedrees Fahr.	
4	2210 degrees Fahr.	
5	2200 degrees Fahr.	2150 degrees Fahr.
New York		
1	2100 degrees Fahr.	
2	2075 degrees Fahr.	
3	2280 degrees Fahr.	2152 degrees Fahr.
Missouri		
1	2180 degrees Fahr.	
2	2270 degrees Fahr.	
3	2170 degrees Fahr.	
4	2310 degrees Fahr.	2232 degrees Fahr.
New Jersey		
1	2450 degrees Fahr.	
2	2520 degrees Fahr.	
3	2175 degrees Fahr.	
4	2360 degrees Fahr.	
5	2250 degrees Fahr.	2351 degrees Fahr.
Ohio		
1	2340 degrees Fahr.	
2	2180 degrees Fahr.	
3	2300 degrees Fahr.	2273 degrees Fahr.
Kentucky		
1	2390 degrees Fahr.	
2	2420 degrees Fahr.	
3	2220 degrees Fahr.	
4	2300 degrees Fahr.	
5	2415 degrees Fahr.	2349 degrees Fahr.
Tennessee		
1	1910 degrees Fahr.	
2	2120 degrees Fahr.	
3	2040 degrees Fahr.	2023 degrees Fahr.

Although natural sands carrying clay bond and originating in different territories are not necessarily uniform for any one territory, still there is a prevailing average in the matter of fusion points typical of sands in each locality. The foregoing table gives the results of fusion tests of clay bond in typical molding sands from several states.

As well as indicating the variation between localities, this table serves to show what may be expected of any clay bond when used without addition of sharp, high-fusing sand. From closer examination of sands with reference to their fluxing constituents, it is almost safe to state that as percentages of the alkalies, the alkali earths, and the iron oxides are high, the point of fusion will be correspondingly low. Fusibility of molding sand is so closely connected with the clayey substance that in foundry practice information concerning the bond will be found to be an excellent guide for the selection of sand carrying high melting points.

Effect of Ferric Oxide.

The color of a molding sand gives a strong indication of the percentage of ferric oxide present, and this, while not seriously detrimental taken alone, nevertheless lowers the fusion point of the clay when a considerable amount of the alkalies or the alkali earths. Sodium, potassium, calcium and magnesium, all act with the ferric oxide toward reducing point of fusion. Calcium and magnesium combine directly with the iron oxide at the moment of fusion. In a high silica sand such as is found in New Jersey and one that is bonded largely by high grade ferric oxide, the oxide may run as high as 10 to 12 per cent and still there will be little trouble in the use of the sand. This fact is determined in the laboratory and is also confirmed in actual foundry practice. If, however, the sand contains 20 per cent or more feldspar the results would be different for the bonding substance in that case would carry more or less of the decomposed feldspar products, which means the presence of fusible constituents in the clayey substance.

Fusion of Bond Substance.

The study of fusibility of clayey substance has been difficult, for the points of fusion are indicated at exceedingly low temperatures. It is hard to reconcile these temperatures with the fact that the sands containing the clayey substance were often successfully used under higher temperatures in the foundry. Molding sands carry anywhere from 5 per cent to 35 per cent of bonding substance. Such substances may fuse at temperatures as low as 1800 degrees Fahr. A bonding substance of 5 or 10 per cent in a molding sand even if of low fusing quality will not produce enough slag under the action of molten iron to cause any trouble on the surface of the casting, if the sand at the same time possesses a coarse grain. This, as a matter of fact, is the explanation covering the use of average molding sands. A growing tendency exists among some foundrymen to select molding sands high in bonding substance. When no precautionary steps are taken the result of this practice is invariably dirty castings. The whole difficulty of fusion trouble may be solved in most cases by keeping the percentage of bond down to just the point of safe working condition and then of carefully holding it at that point from day to day by addition of new sand.

Of course the question of fusibility is not a cut and dry matter which may be overcome by addition of sand alone. The size and weight of castings must be given serious consideration. In case of stove plate sands, for instance, where the feldspar content often forms half of the total mineral matter of the sand and where the clayey substance therefore carries an unusual large amount of easily fusible material, and furthermore where the sand grain is fine, smooth surfaces may still be secured in the case of light thin castings. The weight of iron in light castings is not sufficient to hold the heat long enough to cause detrimental fusing. In other words, the time element is an important one and sands which will not fuse under a quick application of high temperature often will fuse when subjected to lower temperatures for prolonged periods.

The grain of a sand as already indicated, plays an important part in the question of fusibility. Coarse sand will not cause as much trouble under similar conditions as fine sand. But when there is trouble after the grain has been opened to a maximum point consistent with the nature of the work a separating medium must be used between the sand and the surface of the casting. A perfectly clean heavy casting weighing several tons or more may be produced in a dry-sand mold by coating the surface of the mold with a sufficiently high grade blacking. When a maximum point is reached in selecting and mixing molding sand to withstand high temperature, further improvement of the surface of the casting may be obtained by protecting it with heat resisting material. Almost all green-sand castings show evidence of sand fusion and require pickling or sand blasting for finishing. The expense of cleaning castings may be considerably reduced by care in the selection and mixing of molding sands.

It is evident that because of the large number of factors entering into any one molding operation no set rules can be given covering refractory qualities of sands. Ramming a mold for instance introduces a new factor. The sand grains are brought into closer contact in certain parts of the mold and the open character is thus reduced causing a greater ten-

(*Concluded on page* 875)

FORMULAS FOR THE BRASS FOUNDRYMAN

Data on Copper, Tin, Phosphorous Alloys

(*Continued from Data Sheet No. 354*)

Worm Gear Blank

	Pounds	Ounces
Copper	90	0
Tin	4	0
Fifteen per cent phosphor copper	6	0

The physical properties of this alloy are:

Tensile strength, pounds per square inch	51,296
Elongation, per cent in 2 inches	43.0

Pinions

	Pounds	Ounces
Copper	87	5
Tin	8	15
Fifteen per cent phosphor copper	3	12

The physical properties of this alloy are:

Tensile strength, pounds per square inch	41,440
Elongation, per cent in 5 inches	22.0

Worm Gear Blanks

	Pounds	Ounces
Copper	88	3
Tin	9	13
Fourteen per cent phosphor copper	2	0

The physical properties of this alloy are:

Tensile strength, pounds per square inch	54,880
Elongation, per cent in 2 inches	54.0

Sheaves

	Pounds	Ounces
Copper	89	13
Tin	7	3
Fifteen per cent phosphor copper	3	0

The physical properties of this alloy are:

Tensile strength, pounds per square inch	54,432
Elongation, per cent in 2 inches	50.0

(*Concluded on Data Sheet No. 356*)

FORMULAS FOR THE BRASS FOUNDRYMAN

Data on Copper, Tin, Zinc, Phosphorous Alloys

(*Concluded from Data Sheet No. 355*)

Gun Metal

	Pounds	Ounces
Copper	86	9
Tin	11	13
Zinc	1	9.5
Fifteen per cent phosphor copper	0	0.5

The physical properties of this alloy are:

Tensile strength, pounds per square inch	43,680
Elongation, per cent in 2 inches	21.0
Reduction of area, per cent	20.0

Gun Metal

	Pounds	Ounces
Copper	86	9
Tin	11	6½
Zinc	2	0
Fifteen per cent phosphor copper	0	0½

The physical properties of this alloy are:

Tensile strength, pounds per square inch	44,800
Elongation, per cent in 2 inches	20.0
Reduction of area, per cent	23.0

Gun Metal

	Pounds	Ounces
Copper	86	8½
Tin	11	12
Zinc	1	11
Fifteen per cent phosphor copper	0	0½

The physical properties of this alloy are:

Tensile strength, pounds per square inch	45,920
Elongation, per cent in 2 inches	25.0
Reduction of area, per cent	25.0

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, NOVEMBER 1, 1920
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

How and Why in Brass Founding

By Charles Vickers

Recovery of Brass from Ashes Is Problem

We would like to get information concerning the best manner of extracting the brass from brass skimmings. Can this be carried out in a small cupola, and if so is the loss very great?

In the case of a small foundry it is usually more economical to sell the skimmings than to attempt to recover the metal; if, however, water tumbling barrels are used to clean the castings a large amount of the brass can be recovered by means of the barrels. The skimmings should be used every day, and not allowed to accumulate; they should be charged into the barrels with the castings, and the recovered brass will be largely in the form of brightly polished nodules, which can be proportioned among the heats and used up. The fine stuff carried off to the settling tank by the water may be recovered, cleaned of iron and also be used in the various heats. It is a problem to dispose of an accumulation of skimmings and sweepings. The metal can be smelted in a cupola if the zinc content is low, or if there is no objection to taking the zinc loss. Cupolas, or blast furnaces, as they are then called, are used for the recovery of nonferrous metal from low grade material. The iron is fluxed away and most of the zinc is volatilized and a metal of low grade results which has to be remelted and refined in other furnaces. To melt these skimmings use limestone as a flux and run them down hot; pour into ingots and use the ingots for castings of no importance.

Adding Nickel to Alloy of Aluminun

We would like to know of the best way to add nickel to aluminum to make an alloy of 90 per cent aluminum; 8 per cent nickel and 2 per cent copper. The castings we are making are of a light nature and we are bothered by their coming pitted. We would be pleased for any suggestions you may offer.

A satisfactory way of making this alloy would be to first make a hardener then melt the hardener and the proper amount of aluminum together in a secondary operation To make this hardener, melt together 40 per cent nickel, and 10 per cent copper. When this alloy is molten, add gradually 50 pounds of aluminum, stir thoroughly, remove from the furnace and pour into ingots. To make the alloy desired, melt together 20 pounds of hardener and 80 pounds of aluminum. This will produce an alloy of aluminum, 90 per cent; nickel, 8 per cent, and copper, 2 per cent.

Any of the usual alloys of aluminum will run successfully castings of thin section Thus an alloy of copper, 8 per cent; aluminum, 92 per cent, runs easily, so also will an alloy of aluminum, 82 per cent; copper, 3 per cent; zinc, 15 per cent.

Brazing Brass Patterns

In our metal pattern work we have to do a considerable amount of brass fitting which could be greatly simplified if we were able to braze brass to brass successfully. We would appreciate your advising us on the best type of fluxing compound to use for this type of work.

The best flux for brazing purposes is borax in fine powder form, which is lightly dusted upon the parts to be joined. The finer the borax is divided the less it will swell when heated, and the less it swells the better, as it is not so likely to push the spelter away from the joint.

To braze together two brass surfaces, first brighten the parts to be joined and next fasten them together after having placed a little speiter solder and borax between the two surfaces. The next operation is to apply heat until the spelter melts. This is usually done with a gasoline torch or a gas burner. In an alternative method the parts can be clamped tightly together with some finely powdered borax between; the spelter solder is placed on top of the joint and is melted. The solder becomes so fluid and searching it will penetrate the seam and hold the two parts together; in fact a tightly fitted rivet can be brazed in this manner as the solder when melted seeps down around the rivet. A spelter solder of approximately 50 per cent copper and 50 per cent zinc should be used for this purpose.

Casting Brass Around Steel Parts

We are making castings of a mixture consisting of copper, 65 per cent; zinc, 35 per cent. We experience trouble from cracking. The castings are L shaped handles with a square length of steel cast in. They crack at the junction of the two angles. The castings are gated on one end.

The question arises whether the castings are not being cracked while hot by shaking out the molds too quickly. If the cracks are found in castings allowed to cool in the molds, it will be known positively that too hot dumping of molds is not causing the failures. It then can be assumed it is a shrinkage crack, that the position of the gate is responsible for holding one extremity of the handle firmly in place. The shape of the other extremity and its natural situation in the mold holds it. Consequently, there is no chance for the particles of metal to come together during the period it is shrinking, and the metal is ruptured at the weakest place.

It will be advisable to shift the gate; slide it along the handle and get it as near as possible to the part containing the chill, or possibly the castings can be gated on the large part right at the end of the chill. A little juggling of the gate, we believe will remedy this cracking.

White Metal Match-Plates

We desire to obtain a mixture of white metal suitable for match plates which must be practically nonshrinking, and if possible we would rather have it expand slightly. We would be pleased to have you furnish us such a mixture.

It is not possible to make a mixture that will expand as all metals have a certain amount of shrinkage. The following alloy is known as *expansion metal:* Lead, 75 pounds; antimony, 16⅔ pounds; bismuth, 8⅓ pounds.

A better metal than the preceding is the following: Tin, 50 per cent; zinc, 50 per cent. This alloy has a very low shrinkage and finds extensive application as a pattern metal. If a harder metal is required, replace, 2 or 3 per cent of the tin with antimony.

Advocates a School for Foundrymen

Mechanical Equipment and Type of Foundry Labor Available Make It Essential That Those in Authority Have an Intimate and Practical Knowledge of Methods and Processes

BY H. R. ATWATER

HOW to increase production is the great problem which confronts the foundry manager of today. No other industry in a period of time comparable to the past two years has ever invested as large a sum of money in labor saving devices as has been expended by the foundries of the country to increase production and make use of the labor available. This development is still short of the needs of the times. The demand for castings of every description has been such that if the foundries could make delivery they could charge their own price. The foundry has been one of *bottle-necks* of the country's industry.

Old buildings and new additions to foundries have been equipped with the most modern labor saving devices and rebuilding and revamping the methods and equipment has fairly started.

When farm hands can get $7 a day agricultural implements are in great demand; likewise when the wages of ditch diggers reach $10 a day and they are still hard to get, machinery to increase their effectiveness will be demanded and used. The same rule applies to the foundry. As yet, only a small percentage of the foundries have installed modern equipment, but it will have to be installed, for labor will not be available at a much lower figure for a considerable time to come, and under competitive conditions the plant with the intelligently selected equipment will have the best of it. It has been well said that—"When life is easy we take things easy. When human labor is cheap we use only human labor and are content. When life becomes more difficult and labor more expensive men use their brains and that means progress."

The last sentence deserves re-reading and careful consideration—"When life becomes more difficult and labor more expensive, men use their brains *and that means progress!*" To each of us that means, "Will I be progressive and do the thinking or will I let my neighbor do it and leave me far behind?"

In a paper read at the Boston meeting of this association in 1917, the opinion was expressed that foundries operated entirely by hand power would feel the handicap so severely under the wages demanded that they could not stay in the business and compete at a profit against the foundry fully equipped with labor saving devices. Observation of plants and what they have been doing since the time of that meeting confirms the prediction. Wholesale changes are everywhere under way in every phase of equipment and method of production.

The difficulties that the foundrymen have had to contend with during the past three years have been many. Probably the greatest has been the securing of sufficient labor to operate existing equipment. The unwillingness of available labor to work in a foundry when there has been a wide choice of other kinds of work offered in which the wage paid was large, has made it difficult to man foundries properly. This has been particularly true in many plants that are not of modern construction and where sanitary conditions have not been of the best. It is particularly true that the best individual workers have been especially careful in selecting the best surroundings.

This brings up for consideration the following vital questions. Not one of these questions is so unimportant that a foundry owner can afford to ignore it or fail to answer it fairly.

Is my business properly housed? Are the various processes in production located and routed so as to necessitate the fewest waste steps?

Are my buildings as pleasant places in which to work as those of neighboring plants? Is the heating right? Are they ventilated to remove disagreeable dust and gases? Are sanitary conditions good; for instance, are the toilets and the rest room for the women in the core room sufficient and are they properly segregated?

Have I competent foundry foremen and superintendents backed by the necessary mechanical training and skill to recognize, install and operate the many labor saving devices used by most progressive competitors?

Are these men actually leaders of my manpower? Are they in the true sense *managers?* as defined by Albert Atwood in a recent issue of the *Saturday Evening Post:*

"What does all this mean, except that organizing, that managing ability is very scarce? We talk about organization in a very matter-of-fact, offhand manner as if it were an easy, simple thing. But we cannot have the goods and service upon which our lives depend without organization, yet how very few of us indeed have the capacity for it!

"Human beings, materials, tools, equipment, working space and appurtenances must be combined. They must be brought together systematically and co-ordinated effectively to accomplish the desired object of providing what the world needs. The human beings in the organizations are always the most important and difficult problem. Yet they are useless without tools and equipment, and the mechanism cannot function and does not function until that force which we call management leads, guides and directs the whole combination, or organization. Management has to pull the lever, and nothing starts until there is a management which creates a spirit, an atmosphere, a set of ideals, enthusiasm, inspiration, a loyalty, orderliness and discipline."

In these times very high wages must be paid even for the most ordinary labor. In many places plants actively bid against each other for such available labor as can and will work in a foundry. For instance a large portion of the molding machine equipment which has been installed during the past several years from necessity has had to be operated by what has been usually termed common labor.

Waste and inefficiency are prevalent in many plants due to lack of proper mechanically trained men to take care of foundry equipment. It is a fact that in many plants where thousands of dollars have been invested in equipment it is allowed to operate in dirt and sand, to become rusty from lack of lubrication, or is left standing with very little or no attention in exposed places. It is a wonder that in some plants any operation at all is possible. This criticism is not confined to individual cases; in fact so general is the lack of care of equipment in the industry, that the Foundry Equipment Manufacturers' association has taken up the matter and is sending out monthly bulletins in an endeavor to educate men to properly care for equipment. We criticize the farmer who leaves expensive machinery in the open, unpainted, at the mercy of sun,

From a paper presented at the Columbus convention of the American Foundrymen's association. The author, H. R. Atwater, is connected with the Osborn Mfg. Co., Cleveland.

wind, frost and rain, yet we can find equally wasteful habits in our own plants.

The ability to produce castings on modern type machines with the class of help available requires able instructors with mechanical ability, first to rig the equipment properly, and second to operate it effectively. There is a great lack of the right kind of men trained in the use of equipment and pattern rigging and with proper mechanical training to install it and instruct others. Muscle and machinery are useless without brains, not only in the front office and at the superintendent's desk but down on the foundry floor. Apparently we are face to face with one of the greatest needs of the industry at this time. This opinion is based upon the many calls that are made upon equipment manufacturers to recommend and find competent men to handle modern equipment and who can get consistent results day after day, in producing good castings and in producing *more* castings. Men of this type are not running around loose. Good teachers are far less common than good operators. Furthermore we may as well recognize the fact that men skilled along the lines mentioned are not being trained in sufficient numbers to meet the demand. This is a serious matter. The time is opportune to suggest to this organization that it could confer no greater benefit upon the foundry industry of the world than to establish a modern school of foundry practice where men who wish to take up the practical and mechanical work of the present day foundry may be sent to be educated and schooled in the matter of proper rigging, handling of equipment, cost accounting, etc. In such a school standardized practices could be taught that could be outlined by a faculty of foundrymen to be chosen by this organization.

A plant organized and operated as a school to which prospective foremen or plant engineers could be sent to serve a definite apprenticeship and turned out with a certificate or diploma, would serve a definite and useful purpose. This would go a long way toward supplying a very great need in the industry, a need that will be felt more keenly and to a greater degree as competitive conditions bring about a still larger use of machines and various labor saving devices in the foundry. Any step which tends to make an industry more productive and less wasteful of man power is a national service. For that reason it is felt that foundrymen in general should support a plant of that character and the sooner the better.

A. F. A. Recommends Appropriation

THE committee appointed by the American Foundrymen's association to act in an advisory capacity to the United States bureau of standards and made up of W. M. Saunders, H. E. Diller, J. L. Uhler and Richard Moldenke, chairman, held a meeting early in the year with Director S. W. Stratton of the United States bureau of standards and those of his technical staff interested in foundry procedure. The period of reconstruction following a great war has brought forward a large number of problems, involving huge necessary expenditures on the part of the government with the result that practically all research work has had to be suspended for the time being. Lack of an approriation has, among other things, ended the studies on molding sand carried on by the bureau.

The meeting at Washington could do nothing further than have a discussion on those foundry problems which could be handled by the bureau in the event of the raising of funds for the work by private endeavor. The several items at issue are the following:

1. *Molding sand.* The preparation of ideal molding sands and a study of the treatment of natural sands to render them as nearly ideal as can be. The testing of molding sands for bond, grain size, permeability, strength, etc., with the development of possible methods for so testing. The thermal conductivity of molding sands as affected by their chemical and physical characteristics when in service.

2. *Mold Finishing Problems.* The treatment of mold surfaces for the production of clean, smooth-surfaced castings.

3. *Cleaning of Castings.* General subject, and details of the several methods. More specially, the sand blast with specifications for the sharp sand, flint, crushed steel, cast iron shot used; desirable blast pressures, etc.

4. *Sharp sand.* For purposes other than sand blast.

5. *The gating of molds.* Effect on internal shrinkage and casting losses.

6. *Chemical and physical laboratory methods.* Simple methods for determining oxygen in cast iron. Microscopic study of phosphorus, sulphur and oxygen in cast iron.

7. *Electric furnace problems.* Desulphurization and deoxidation of cast iron.

8. *Mixture standards.* Standard mixtures of automobile cylinders and other castings.

The foregoing items embrace some pretty big and fundamental foundry problems and would tax the ability and persevering effort of all the living foundry metallurgists and experts. There is no better place for carrying out scientifically accurate investigations along the above mentioned lines than at the laboratories and workshops of the bureau of standards, and as congress could not grant the means for instituting this work, it would seem up to the industry itself to take the initiative by raising sufficient funds to maintain one or more investigators at the bureau.

Director Stratton extends the use of the bureau facilities to the foundry industry and will assist in the selection and training of the right kind of men to carry out the program. Several industries have already established fellowships in this way, and the interests and problems of these industries are well cared for in this particular respect.

Your committee respectfully recommends that the executive board of the American Foundrymen's association be asked to take the question up with the membership, and with the boards of kindred bodies interested in foundry work, to see if it is not possible to establish a fellowship for foundry investigation under the auspices of the United States bureau of standards. Five thousand dollars annually would be a comfortable amount, though $2000 would do much if no more can be made available. With the increasing number of foundry schools training young men interested in the industry, the right kind of material is available from which to pick men who will devote their lives to research work in cast iron. The results will soon be manifest for the good of foundry practice.

From a report submitted by Dr. Moldenke, chairman of the committee to the convention of the American Foundrymen's association at Columbus, O., Oct. 4-8, 1920.

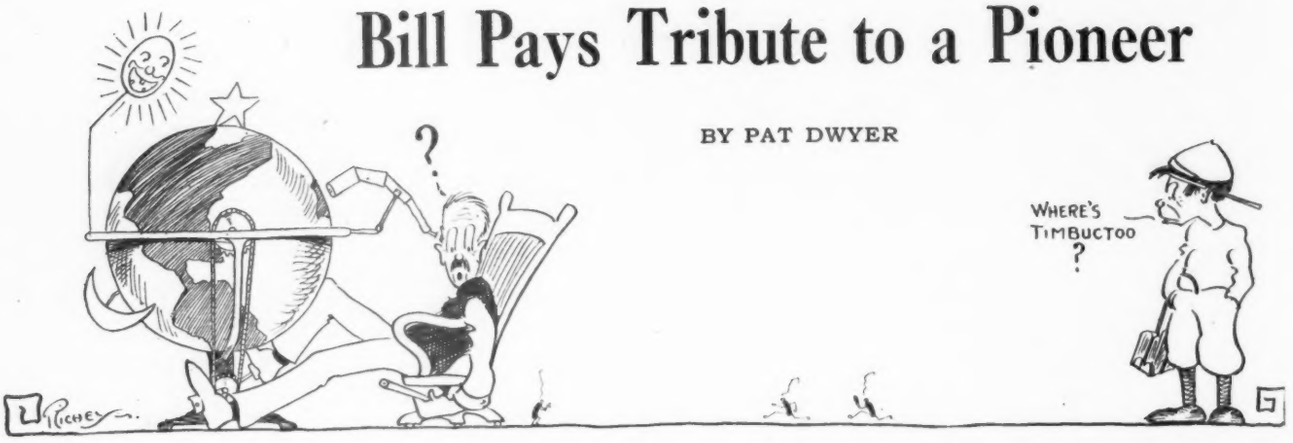
Dutch Industrial Fair

The Fifth Industries fair which for the first time will be of an international character will be held at Utrecht, Holland, from Sept. 6 to Sept. 16, 1921. It is announced that it will be under the patronage of her most gracious majesty the queen and under the auspices of the Dutch government. All foreign manufactures and products will be admitted to this fair. Detailed information of any description in connection with the fair may be had from the general secretariat, Vredenburg, Utrecht.

The Automotive Castings Co., Inc., Imlay City, Mich., has purchased the plant of the Merrill Mfg. Co., of that city and will manufacture there.

Bill Pays Tribute to a Pioneer

BY PAT DWYER



AFTER considering the matter carefully for many years, I am of the opinion that a large measure of thanks if not of gratitude and applause will be the portion of the man who institutes a society for mutual instruction and improvement among the poor and downtrodden fathers of families. These reflections are the direct result of experience gained in recent years or to be more exact since the older children left the comparatively safe ground covered by the three R's and taken up courses of studies that make me realize that I am only a dabbler, a neophyte and a babe in the wilderness. It makes me sympathize with those unfortunates who gain a certain reputation through some fluke of fortune and then are confronted with the agonizing necessity of living up to it all the days of their lives.

Instead of assuming a stern and haughty demeanor when the children were young and beating them up with a club or a poker when they asked my assistance in solving their junior scholastic problems I was foolish enough to treat the matter lightly and parade my meager store of knowledge for their benefit. How little I realized that I was placing a weapon in their little chubby hands which in later years would be cheerfully if unconsciously used to my dismay.

On account of the intimate personal relations maintained in those early days they got the impression that "Paw knows everything." Now I am confronted with the bitter alternative either of relinquishing this position in their minds or entering upon a course of studies that would tax the courage and endurance of at least two young, strong and healthy college professors. If I had my life to live over again I would—but what's the use? I am here and they are here and while there is life there is hope that perhaps the school will burn down some day—soon. I was turning the problem over in my mind the other night after supper and mentally erecting a first line defense against the bombardment of questions which were due after the dishes had been put away and the books brought out, when providentially Bill came in and it was up to me to exercise the sacred rites of hospitality.

I offered him a chair and a paper of tobacco. He accepted the first, but declined the second after a look and a smell.

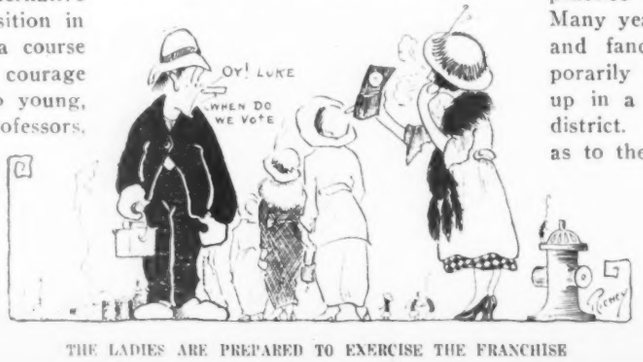
"When I smoke," said he, "I like to smoke real tobacco. That scented hayseed you have there reminds me of the old darkey's comment on this modern substitute for what made Milwaukee famous. 'Dis heah stuff,' said he, 'looks lak beah, it smells lak beah, it even tastes lak beah; but when you gets it down it ain't got the authority.' "

He filled his pipe with some stuff that was scented like—but scented is not the word. The only lady in the house who calls me by my first name, sometimes, and who has a disconcerting way of using the right word in the right place, applied several terms to Bill's tobacco and none of them had any reference to the perfumed breezes that blow o'er Ceylon's lovely isle. Bill simply grinned and puffed away contentedly.

"I am going to make hay, metaphorically," said he, "while the sun shines. Now that women have secured the right to vote, I expect the next step will be to curtail the few privileges left us since the Volstead act went into force. I have the greatest respect for the ladies and while in former years I may have had some misgiving about it, I know that in future I shall be able to endorse heartily the toast, 'the ladies, God bless 'em, we can't live either with them or without them.' What with attending political rallies and caucuses and electing their favorite candidate according to the way he wears his clothes and his personal appearance, I see where we shall have to live without them a considerable part of the time. When they are at home partizan politics will be one more added to the already long list of reasons why men leave home and stay out all night.

"However, there is no need of shaking hands with the devil until you meet him and the ensuing four years may be endurable no matter which party is successful at the polls on Nov. 2. The country seems to have made fair progress during the past 100 years despite the fact that the administration has changed many times during that period. Of course whatever progress was made is due entirely to the wise and statesmanlike administration of our favorite party and was accomplished in spite of the negative efforts of the hated opposition when they happened to hold the reigns of power in Washington.

"Times change and the people change with them. Take our own business for instance and contrast the old time foundries, the buildings and practice with those of the present day. Many years ago when I was footloose and fancy free, I was located temporarily in a town which had grown up in a coal mining and steelmaking district. Without being too specific as to the exact year I might say that it was during the period when every young man's ambition was to wear a moustache, a pair of light colored spring bottom pants and a coat and vest made of diagonal cloth. I re-



THE LADIES ARE PREPARED TO EXERCISE THE FRANCHISE

sisted the temptation of the moustache; but the clothes—Oh Boy!—whenever my wife feels blue now-a-days all she has to do is look up an old photograph I had taken in those weird habiliments and laugh until she becomes tired. The first settlement of the town dated back over a hundred years and one of the interesting landmarks was a little old foundry, still running, which was among the first buildings erected.

ELECTION DAY IS USHERED IN BY FASTING AND PRAYER

"The foundry was operated in connection with a mine or to use the local term, a colliery which had been opened by a company known as the General Mining association. The company was of a much more conservative character than the Company of Gentlemen Adventurers Trading Into Hudson's Bay, which had been established a century or so before; but like the latter, formed a link in the chain of the empire whose 'morning drum beat following the sun and keeping company with the hours encircles the earth with the martial music of the greatest empire the world has ever known.'

"The head office of the company was in London and when they opened this mine in a foreign country they also had to send an organization and equipment to operate it. Away back in the early days of the nineteenth century, foundries in the colonies were few and the management was confronted with the alternative of sending to England for repair castings at a time when the average round trip consumed from four to six months; or of putting up a foundry on the mine property. They adopted the latter course and although it had been in existence for about three-quarters of a century when I first saw it, it was to all intents and purposes the same as when the first master founder, who had come out from England, was running it.

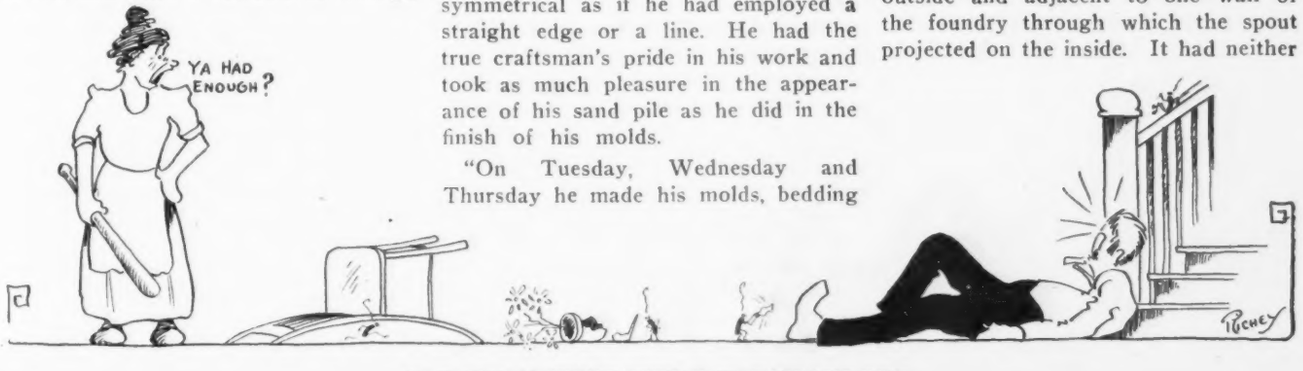
"Like many other British institutions, the position of master founder in this shop had descended from father to son and when I rambled in through curiosity one day, I found a venerable appearing old man who assured me that he was 72 years old and the grandson of the original foundryman. If he had told me that he was the grandson of Tubal Cain I would have believed him quite readily for with his piercing eyes, that had never known spectacles, and his long patriarchal beard he certainly looked the part.

"Considering their facilities some really remarkable jobs had been made in this ancient foundry; but economic and business changes gradually had diverted most of the work to other and more modern shops which had been established in the country and at that time the only castings made in this old time foundry were grate bars, coal tub wheels and general odds and ends. The old man was foreman, superintendent, general office and foundry force and in fact the whole works.

"He ran off a heat once a week, on Saturday morning, and in the afternoon he took a holiday and worked in his garden. On Monday morning he pulled all the castings out of the sand and piled them in a lean-to at one side of the shop where they were cleaned by a helper detailed from the colliery force for that purpose. The old man then wet down his sand and cut over all the heaps. This job was too exacting to entrust to any helper. He handled the shovel with equal facility with either hand and without once looking behind could send a cascade of sand flying off the end of his shovel and leave the heap piled in a windrow as straight and symmetrical as if he had employed a straight edge or a line. He had the true craftsman's pride in his work and took as much pleasure in the appearance of his sand pile as he did in the finish of his molds.

"On Tuesday, Wednesday and Thursday he made his molds, bedding all in the floor, and covering them with iron copes which were weighted down afterward with pig iron. When necessary, he devoted an hour or two to making cores and drying them on an open plate superimposed on an old-fashioned beehive stove. On Friday he chipped and daubed the cupola, made up the sand bottom and arranged his shavings and kindling wood. The last thing before going home he daubed his ladles and built a little fire in each one. The fire in the cupola was started the first thing on the following morning and a couple of helpers charged the coke and iron under his direction. Shortly before putting on the wind he arranged a few pieces of hand picked coke in the breast opening and having set a short piece of 1-inch pipe to form the tap hole, rammed the breast. He then cut out around the pipe in a graceful curve with his trowel, withdrew the pipe, daubed the spout and slicked it straight and true and rounded nicely at the end. The spout and tap hole were blacked with two or three long skillful strokes with a swab and a small fire built in them to dry them.

"The cupola itself deserves special mention. I was going to say it resembled nothing in the heavens above, the earth beneath or the waters under the earth. I have learned since that it was a type common in the old country; but I have never seen anything like it. It was built solidly on the ground like a blast furnace. After the heat was over the breast was knocked in and all the slush, slag and half burned coke pulled out with a long handled iron tool like a hoe. The square shell was about 10 feet high and was made up of a number of cast iron plates about an inch thick which had been cast in open sand. They were bolted together at the four corners by a number of lugs provided for that purpose. The cupola was lined with fire brick in the usual manner and was erected outside and adjacent to one wall of the foundry through which the spout projected on the inside. It had neither



BE IT EVER SO HUMBLE THERE IS NO PLACE LIKE HOME

smoke stack or charging door; but was charged directly through the top which stood about a foot above the charging platform.

"The method of charging also was unique inasmuch as no regular sequence of alternate layers of coke and iron was observed. After the bed charge of coke had burned through the coke and iron were thrown on in an apparently indiscriminate manner. However, the job was done under the watchful eye of the old man who gaged the relative quantities instinctively and with unerring judgment. Certainly the iron which he obtained was equal to anything I have seen since and I guess I must have seen a million tons or more since that time.

"The blast was supplied by a small fan in the adjoining blacksmith shop and entered the cupola through two small tuyeres located on opposite sides. The old man attended the furnace personally, tapped her out and stopped her and then skimmed while two laborers poured the ladles. If they splashed a drop of iron around the runner or failed to cut her short when he yelled 'UP' he hurled at them the fiercest, quaintest and most picturesque old English imprecations I ever had the pleasure of hearing."

Bill rose to go and said, "Well, I must depart on the master's business. We had some difference of opinion recently owing to the fact that she favors one political party and I favor the other. However, we signed a peace treaty last night and contrary to the usual run of peace treaties the terms are perfectly satisfactory to both parties. We compromised, I promised to vote for her candidate and she agreed to vote for mine."

Make Patterns To Suit The Foundry

BY M. E. DUGGAN

AN interesting article by R. R. Clark, on changing patterns to the best way of molding appeared in the January issue of THE FOUNDRY. In this article Mr. Clark deals with the simple, plain and easily made patterns, the kind that the patternmakers are called upon most every day to make.

Mr. Clark asks the question, "What is a good pattern?"

A good pattern is one that is made complete, or sufficiently perfect in form, with qualities best adapted to its design and use, and is constructed in a way that will answer the purpose for which it is intended. It may be used for one casting, or for 100 castings, or it may be a standard pattern from which thousands of castings are produced.

A good pattern should be constructed in a way that will meet the requirements of the foundry so that a mold can be made with a minimum amount of labor, in the shortest time that is possible and with the least expense to the foundry.

When I say "half-made patterns," I do not intend to reflect on patternmakers in general, or the patternmaking trade. I have worked with men, who call themselves draftsmen, designers and engineers, ponder for days, weeks and months over a drawing board, designing and making the drawings for some complicated machine or mechanical equipment, then, when they had finished the drawings, they passed them to the pattern department accompanied by an order on which was stamped, in large letters, the word *rush*. Why this rush? Why not simplify the design in the drafting room and thus avoid the rush in the pattern shop?

No one is competent to simplify the design of a machine or the parts for a machine unless he knows the workings of the pattern shop, the foundry and the machine shop. Further, no patternmaker is competent to construct a practical pattern who is not familiar with the workings of the foundry.

I was employed in the pattern shop of a plant employing 15 patternmakers for about two years. During this time I did not see a draftsman in the pattern department. I visited the foundry only twice, both times I was accompanied by a guide whose duty it was to see that I wasted no time in observation or asking questions of the molders, other than what pertained to the job in question. Many things were done in this pattern shop according to shop *system*. If you should ask the patternmaker why, he could not answer you.

Practical Instruction Needed

In another shop where I was employed as patternmaker, there were two apprentices, one just out of his apprenticeship term, and the other with about two years' experience at the trade. There were no foundries in that town. This shop employed about 40 machinists. All of the castings were made in a foundry located in another town, 42 miles away. I asked the young man who had just served his apprenticeship, if he visited the foundry often. He replied that he did not know what the inside of a foundry looked like. His knowledge of foundry work was obtained from the men who worked in the pattern shop.

Imagine this young man starting out in the patternmaking world, bumping up against *old rounders* in patternmaking and foundry lines. Why, he would not have one chance in a hundred to make good unless, by some good fortune, he got into a shop where there were some kindhearted fellows who would help him along.

I spent six years in the shop where I learned the patternmaking trade. To be sent to the foundry, which was located about a mile from the pattern shop, was considered by the apprentice boys to be quite a treat. After serving four years at the pattern making trade I was told by the boss patternmaker that I was competent to go out as a journeyman. This man told me an untruth, I was never taught foundry practice in a foundry and consequently I was not competent to start out as a practical patternmaker. Learning foundry practice in a pattern shop is the poorest kind of teaching because instruction is given by men who do not understand how the molder or the coremaker does his work, nor what is required by these men in the foundry and in the core room.

"Any man who can handle a saw and an axe can make patterns," has been affirmed. Let me cite an incident that happened in a large jobbing foundry a short time ago. In the cleaning room of this foundry I picked up a casting of peculiar and complicated construction. The dimensions were about 8x8x8 inches over all. I estimated the cost of the pattern and core box to be about $65. On account of the complicated design of both the pattern and the core box time and weight were charged in the production of the casting. Only one casting was made from this pattern, the molder having refused to continue with the job until the pattern was changed to meet the requirements of the foundry. The man who made this pattern was not in the *saw and ax* class, but the draftsman or designer who was at fault had a very limited knowledge of what is required by the foundry in the pro-

duction of castings of this kind.

At one time I was employed to construct patterns for a rotary steam engine. The cylinders and cylinder heads were designed with a water-cooling system. I made the patterns all right, but when it came to making the core boxes I did considerable guesswork. There was no one to check up my work and it went to the foundry just the way I made the job. The castings were produced, machined and the first engine was built.

Several short time tests were made which proved satisfactory to the designer of the engine. He decided to couple the engine to an electric generator and invited representatives from the different electric companies to see the engine in operation. At the appointed time the tests were started. After running but a short time, the engine stopped with a sudden jerk. It could not be started again as every moving part of the engine was cemented together as if it were a one-piece casting.

The engine was taken apart and the cylinders and cylinder heads cut apart through the center of the water chamber, to learn the cause of the trouble. It was discovered that I, through my ignorance of foundry practice, had so constructed my core box that the cores at one point were joined together. This closed the water passage and cut off the circulation in the cooling chamber.

The next time the designer turned the patterns over to a practical patternmaker familiar with foundry practice. The engine built from the altered pattern was a success.

One year's experience in a foundry at the start is worth more to the apprentice than five years in a pattern shop without foundry teaching. If he does not get this foundry experience while an apprentice he will be forced to acquire it when a journeyman. The one thing that is necessary to make a practical patternmaker is foundry practice.

Judging Foundry Sands

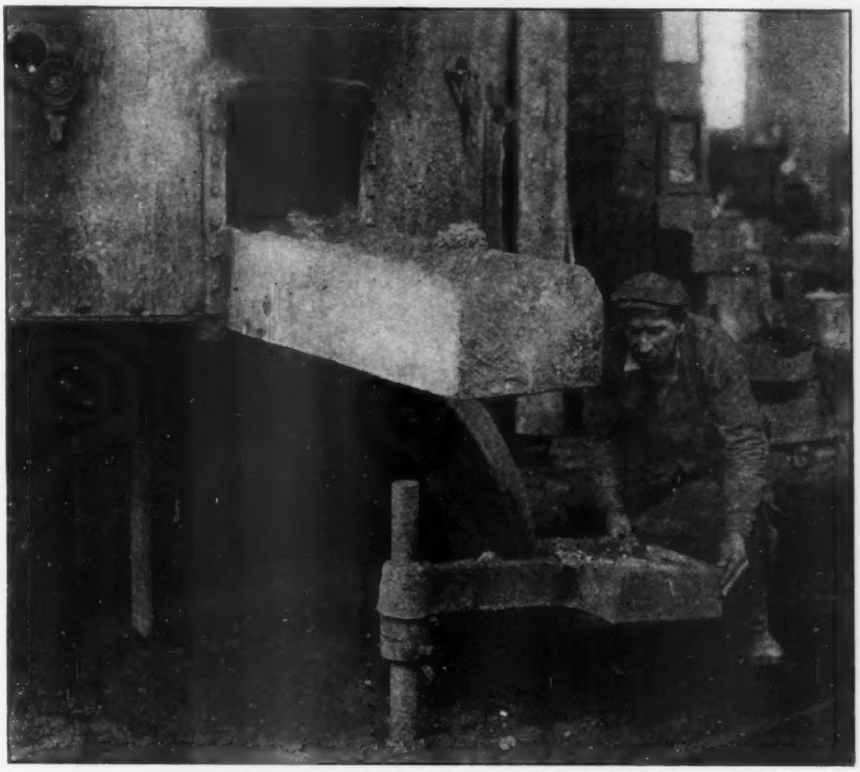
(*Concluded from page 868*)

dency toward fusing. This may be overcome by the selection of sand grains of the right shape to resist the action of ramming. Sharp irregular shaped sands will pack more densely than uniform, well-rounded grains. Round grains also carry a more uniform coating of bonding substance.

So far the fusibility of materials other than quartz, feldspar and clay has been disregarded. The reason for this is that with the exception of mica such other substances are not found in sufficient quantities in molding sands to make their presence detrimental in a refractory sense. Mica has a melting point of 1922 degrees Fahr; low enough to cause trouble if present in large amounts. However, it is seldom present in detrimental proportion. Only in the selection of sands for steel casting work does the presence of mica need be considered. In general, increased refractory qualities will be obtained where castings are light in weight; sand is coarse and open in structure; much ramming is not done, or if done, grains are round and uniform; and percentages of alkalies and alkali earths are low.

Revolving Rig Holds Bull Ladle In Position

In the ordinary method of catching metal in bull ladles from the cupola spout, it is necessary either to set the ladle on the ground or to hold it on the crane hook while the metal is running into it. Both methods entail unnecessary work, and cause fatigue to the ladle carriers. To avoid this the Vahan Foundry Co., recently purchased by the Superior Foundry Co., Cleveland, installed the device shown in the accompanying illustration under the spout of the cupola. This consists of a steel bar imbedded with concrete in the floor. On the upper part of this spindle a cast-iron arm is attached with a bearing, which allows it to rotate on the spindle. When the heat is being poured the arm is swung out in front of the cupola runner box, and ladles are set on the square platform cast on the end of the arm. When not in use the arm is swung back out of the way. The height of the arm is regulated by collars attached to the spindle with set screws.



THE STEEL POST SUPPORTING THE ARM IS ANCHORED IN CONCRETE

To Decide Sulphur and Phosphorus Limits

Work of the joint committee of the different technical societies to study the effects of sulphur and phosphorus on steel was said to be progressing energetically by A. R. Bull, representative of the American Foundrymen's association on the committee, in his report at the annual convention of the foundrymen's association. Mr. Bull said that it is planned to issue a questionnaire to the steel casting manufacturers requesting that they set aside suitable steel castings which contain high percentages of phosphorus or sulphur which are occasionally made in heats that are off in analyses. Thus the idea is to accumulate a suitable number of steel castings to ascertain by testing the effects of phosphorus and sulphur in cast steel. The questionnaire will indicate the sections desired which may be cut from the castings and will deal with annealing, as well as the history of the heats involved together with other data.

Standardizing of Gray Iron Samples

Lack of Recognized Standards Which Specify the Method of Taking Samples of Gray Iron Castings for Test Purposes Greatly Impairs the Work of the Laboratory

BY EDWARD J. FOWLER

IN THE field of gray iron products, or at least cast products in which the ratio of the combined and graphitic carbons play an important part, there is a woeful complexity of sampling methods which should compel attention for the purpose of arriving at some method whereby records from varied sources will gradually create an interest in the importance of the carbon ratios for the benefit of the trade and for the establishment of true analytical records.

At present, without a recognized standard, the average foundryman has his sample taken from various parts of castings. While the usual metalloids do not vary to any important extent, the carbon ratio is dependent almost entirely upon the cooling rate of the casting. If a sample is taken from a half-inch section of a long flat plate the combined carbon differs from a similar half-inch section closer to a heavy section with tendency to delay the cooling effect of the sand; in fact, the combined carbon content materially differs in half, three-quarter, or 1-inch sections so that the foundryman is in the position of not only directing that a sample be taken but also must signify from what part of the casting such sample should be taken and in recording such results he is confronted with the necessity of a complex description of where the sample was taken. He may direct that a sample be taken from a pulley and if the pulley happens to be on the boring mill these chips are used for a sample and may give a reasonable indication of the carbon ratio. On the other hand a sample taken from a rim or spoke may show a ratio which would explain some defects of mixture easily remedied.

Carbon Records MisLeading

It perhaps is unkind to say that practically all of the published carbon ratio determinations are useless; but this is at least a half truth when one considers the distrust surrounding a result which is not backed up by some statement showing where the sample was taken.

Frequently a foundryman who prides himself upon good foundry practice and complete records, publishes carbon ratios showing a cylinder analysis of, say combined carbon 0.60 per cent, graphitic carbon 2.60 per cent together with a pulley showing combined content of 0.80 per cent and graphitic carbon 2.40 per cent. This is good as far as it goes, but where was the sample obtained?

It must be admitted that it has taken a great many years for foundrymen to assimilate the fact that not only is the total carbon of interest so far as material going into the cupola is concerned but that the carbon ratio is important in the product. Even now some pig iron producers set forth the combined and graphitic analysis of their pig as proving that with low combined carbon in the pig, the foundryman can get low combined carbon in his castings.

Carbon Records Important

This fallacy is fast disappearing with the growing importance of the semi-steels, the air furnace and the electric furnace, whose results are so dependent upon the total carbon and the consequent ratio of combined to graphitic. Therefore, now as never before, we should be accumulating carbon records which gradually will build up a theory of the composition of cast iron which will be of great benefit to the trade.

Cast iron at its best is a conglomerate mixture of various metalloids and compounds with various melting points; and all coming down in an apparent liquid stream which in reality consists of a melted fluid carrying along with it pasty compounds of varied formulas. These affect results and cannot be determined by the chemist in the usual commercial analysis. With prevailing various higher working temperatures, we are discovering new and better irons; largely accounted for by the complete melting of such compounds so that their influence can directly improve the mixtures.

These facts are cited for the purpose of calling attention to at least one reason for a standard analysis sample casting. For some years the writer has consistently pursued the plan determining a suitable form of sample or a method which is comparative.

First it semced possible and desirable to take a part of the physical bar for this purpose but this was discarded for the reason that for some purposes the A. F. A. round bar was used, for others 1-inch x 1-inch x 14-inch bar for 12-inch centers; and also the 1-inch x 26-inch for 24-inch centers; to say nothing of the round and square coupon bars desired at times by various engineers.

Second, the sample should be poured in green sand at all times to get at comparative results, or in dry sand if such practice was to become standard.

It finally was decided that a green sand sample or plug would be most simple and desirable for average foundry practice and the following plan has been in force for about eight years.

Eight to 20 plug patterns are made depending upon how many samples are generally desired. These plugs are 1¼ inches x 1¼ inches by about 4 to 6 inches long, each plug pattern having a pattern lead letter on the bottom, 1, 2, 3, etc., showing on the cast plug. The plugs are molded on end in a drag, no cope being used, and are molded in succession 1, 2, 3, etc., and separated about 6 inches from each other to prevent undue results on account of the influence of heat from plugs already poured. The foreman directs that plug No. 1 be poured from third tap; No. 2 from sixth tap, etc.; or a plug can be poured from each tap if a special check is required. Bars for physical tests are poured separately. This requires no special direction from the office other than the order "take bars and plugs today." Each plug is poured down the mold without any gate. When the drag is shaken out we have a series of numbered plugs which are brushed with a steel wheel brush to remove all sand. Drillings are taken on the side and put in envelopes numbered to conform with the plug numbers. These envelopes are sent up to the office for record and analysis.

Method Is Adjustable

As a general rule when no special tests are required a composite is made for the laboratory sample, consisting of an approximate equal amount of drillings from each envelope; but the envelopes can be saved until results come in and any part of heat can be checked by turning in such envelope if required.

The plan is susceptible to varied changes to suit local conditions or special tests all will without the necessity of any involved instructions. The net result is that all analyses are comparative with the results of earlier years and particularly desirable as records increase. The net results of checking

From a paper presented before the 25th convention of the American Foundrymen's Association held at Columbus, O. the week of Oct. 4-8, 1920. The author Edward J. Fowler is connected with the Pacific Foundry Co., San Francisco.

are that where a plug sample has given 0.60 per cent combined carbon the same iron in one casting has always run 0.80 and in another 0.50, so that from having our plug results we can often determine that the machine shop should improve its tool practice. This plan surely has resulted in a minimum number of even occasional complaints. Moreover, the records show that; say a 0.60 combined carbon gives certain results in certain castings; and further if a standard plug is used all printed records can be referred to as A. F. A. standard.

It is quite probable that some better form of sample or some better method can be devised than the plan herein proposed, but in any event the writer believes the A. F. A. should make an investigation and propose a plan whereby accuracy in this respect may be assured, thus removing the general prevailing idea that a foundry is the father of inaccuracies and that a molder knows no closer measurements than the quarter inch marks on the face of a rule.

Reservoir Required To Pour Large Mold

AN UNUSUALLY large ingot mold casting recently was made for the Pittsburgh Crucible Steel Co., Pittsburgh, by the Buffalo Foundry & Machine Co., Buffalo. The casting was 17 feet 2 inches long, and in order that a thoroughly sound casting might be obtained, it was poured on end. To accomplish this, the mold was erected in a pit extending 14 feet below the floor level. Due to the fact that water is reached at 8 feet below the floor line, it was necessary to make this molding pit absolutely water tight.

In pouring castings of this character on end, it is customary to cast large risers or headers on the casting. This provides a quantity of metal upon which the casting itself draws, and any impurities in the metal come to the top of the casting in the riser, which is later removed. Experienced foundrymen will appreciate the difficulties encountered in pouring on end a casting of this weight and character.

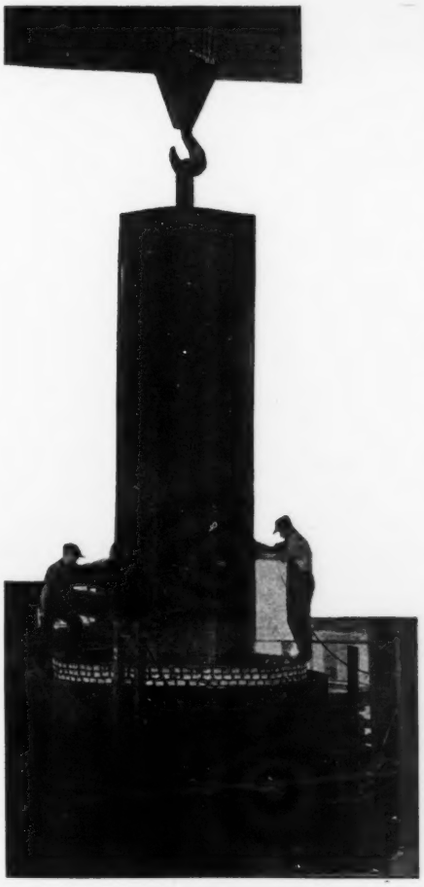


FIG. 1—LOWERING CORE IN MOLD—THE PIT EXTENDS 14 FEET BELOW THE FLOOR LEVEL

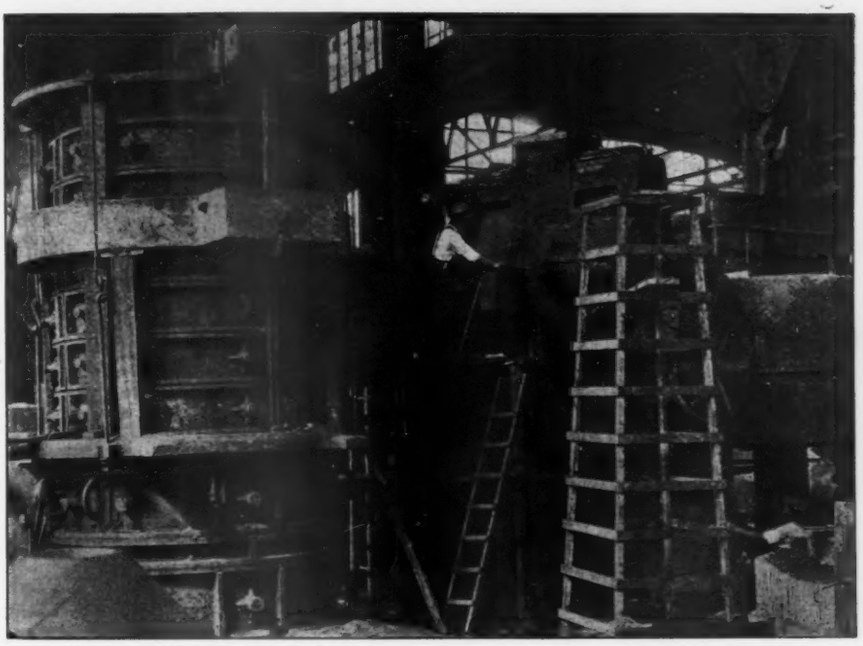


FIG. 2—RESERVOIR AND MOLD JUST BEFORE METAL WAS POURED—THE RESERVOIR, SHOWN AT LEFT HAD CAPACITY OF 70 TONS

One of the important requirements was that the diameters of the mold should be the same at both ends. Owing to the height of the casting, and the consequent high head of liquid metal, it was evident that the pressure at the bottom of the mold would be a serious factor in pouring this casting; in fact, the pressure at the bottom would be so great that there would be a tendency to crush the core and force the walls of the mold inward, thereby reducing the diameter of the casting at this point. One of the problems, therefore, was to construct the core so that it would be sufficiently strong to withstand this crushing tendency, and at the same time be sufficiently pliant to yield to the shrinking process which takes place as the casting cools and also be sufficiently porous to allow the escape of the gases generated in the core through contact with the heat of the molten metal. As the rate of shrinkage in the diameters at the bottom of the mold would be different from that at the top, it was of course, necessary to regulate the diameters of the core and mold at the top and bottom so that when completely cooled and after shrinkage had ceased, the resultant diameters at both ends of the casting would correspond.

Reservoir is Provided

The weight of the finished casting is approximately 114 tons, but a total quantity of 135 tons was required to pour it, the excess representing gates, runners and the riser. In order to have this large quantity of metal ready for pouring at one time, it was necessary to make special provision for storing a large portion of it. This was done by building a large reservoir with a capacity of 70 tons adjacent to the mold, as illustrated in Fig. 2. This reservoir was made up of cast iron rings and properly lined with fire brick and clay to hold the molten metal. In addition there were three ladles of molten metal holding 25, 30 and 10 tons, respectively. The 70-ton

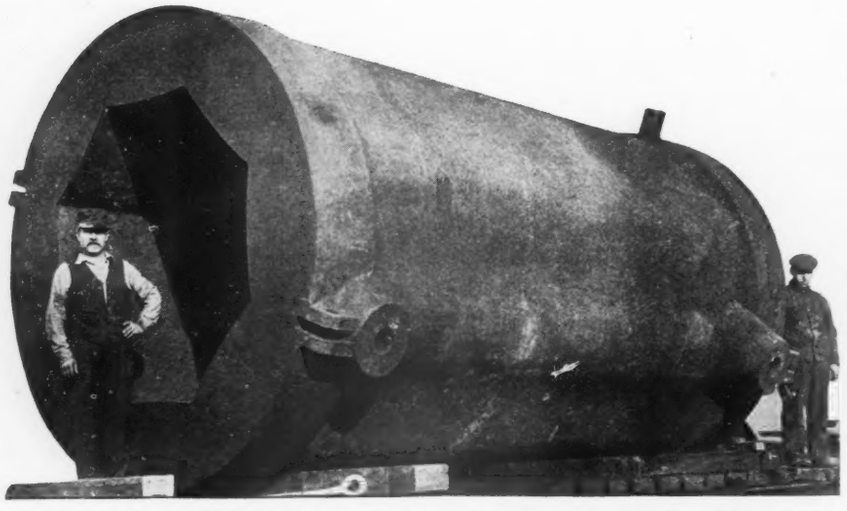


FIG. 3—FINISHED CASTING READY FOR SHIPMENT—THE INGOT MOLD WEIGHS APPROXIMATELY 114 TONS

reservoir was connected to the mold by a runner or trough, and at the proper moment the plug at the bottom of the reservoir was withdrawn, releasing the molten metal to the mold through the trough. At the same time the ladles were poured into the mold through other runners.

An idea of the crane capacity required for handling castings of this kind is afforded when it is stated that in addition to the casting, which in itself weighed 135 tons with the riser and gates, there was also the core, which required handling at the same time. It therefore is probable that the total weight handled exceeded 200 tons. Fig. 3 shows the finished casting as it lay on its side on a number of blocks ready to shipped to its destination in Pittsburgh.

Zirconium Is Deoxidizer In Cast Iron

TO THE list of deoxidizers useful for the purification of cast iron there has been added another ferroalloy, namely that of zirconium. As the list of elements ordinarily in or added to cast iron grows larger a more thorough understanding of the functions of each one of them, particularly those more rarely met with, becomes of increasing importance. We are all familiar with the action of silicon, carbon, phosphorus, manganese and sulphur, but know very little about the special efforts of vanadium, titanium, cerium, copper, nickel, chromium, etc. Year by year more of the rarer elements come into daily use, and as they become more reasonable in price through quantity production, the iron industry experiences a corresponding expansion into new fields of usefulness.

For cast iron the elements involved seem to be divided into two groups. The first is made up of those not readily removed by oxidation in ordinary good foundry melting practice. The second consists of the elements readily oxidized under conditions involving the presence of oxygen in the molten metal. The two groups shade into each other to some extent, depending upon the degree of skill possessed by the foundryman in handling his cupola or furnace.

The above will be better understood when such elements as sulphur and phosphorus are considered. Both are increased in melting practice by concentration, as they are not oxidized out. Only the action of a basic hearth in open-hearth or electric furnace practice will reduce these elements in quantity, and only through chemical reactions of a more or less complicated nature. On the other hand, it is known that silicon, and manganese undergo definite losses in the melting operation, and mixtures are made up with this situation in view. The behavior of carbon and iron itself is less certain. Both oxidize under conditions of high heat and the absence of a sufficiency of manganese and silicon to protect them. Most foundrymen have seen the brown smoke emanating from a cupola indicating a low bed and burned iron, when the silicon of the mixture was below 1 per cent and manganese nearly all gone. In air furnace practice the reduction of carbon is well known, and in long heats there is enough iron oxide in the bath to yield defective castings.

Grading Elements

For the group of the less easily oxidized elements in cast iron, where melting is carried on under the best possible conditions of air supply to the fuel to prevent undue oxidation, the following list may serve. It is thought that the order given may be that of the most stable first and so on to the middle ground. This order may be phosphorus, sulphur, iron, copper, nickel, tungsten, molybdenum and carbon. Then from carbon as ready to be oxidized or remain unaffected, depending upon the care taken in melting in cupola or furnace, the order of the elements readily oxidized may be carbon, chromium, zirconium, silicon, manganese, vanadium, aluminum, magnesium, titanium and cerium. The last named is probably the one most easily oxidized.

The order above given is practically guessed at, as there is no definite information available on the subject. The writer has an intuitive feeling that it is so from the practical observations made when handling the elements in question in their ferroalloys. It would be interesting to subject iron alloyed with all of these elements to a very slow oxidizing atmosphere while in the molten state, and make continued analyses to observe the rate of elimination of each as the test progressed. This should give the order of removal and by inference, the degree of efficacy for purposes of deoxidation in cast iron.

From the many tests made by the author of deoxidizers of cast iron, it seems that the first effect is the removal of oxygen present in combination with the iron. This eliminates just the amount of the element in question necessary for that laudable purpose. If the alloy added brings in more than enough for this deoxidation, the balance of the element remains in the cast iron and exerts its particular function upon the properties of the casting. Thus, the addition of say 0.1 per cent titanium may remove all the oxygen present in a ladle of molten iron and yield results that are practically as good as if 0.2 per cent had been used. It is the removal of oxygen—the weakening factor in the molten metal—that permits it to come out with its natural strength due to its composition. It seems as if the crystals adhere more firmly and are given the chance they should have for strength due to a good analysis. If these crystals are of finer quality as the result of added nickel or molybdenum, and if the graphite crystals are small and not too large in number, the product should be a pretty high class metal. Many claims are made for vanadium and other of the rare elements for cast iron and doubtless

From a paper presented by Dr. Richard Moldenke, Watchung, N. J., before the American Foundrymen's Association at the convention held in Columbus, O., Oct 4-8, 1920.

GRAY IRON MIXTURE

Pig 60 per cent, gray scrap 40 per cent. Average of three bars each.

Breaking Strength pounds	Deflection inch	Zirconium added per cent
2,700	0.10	none
2,920	0.11	0.05
2,900	0.11	0.10
3,050	0.11	0.15

WHITE IRON MIXTURE

Scrap Car Wheels 60 per cent, white iron scrap 40 per cent. Average of three bars each.

Breaking Strength pounds	Deflection inch	Zirconium added per cent
2,640	0.10	none
2,790	0.10	0.05
2,880	0.11	0.10
2,940	0.11	0.15

there is much to the subject. Fundamentally, however, the less oxygen present in the metal before the ferroalloy addition, the more characteristic the effect. Hence the soundness of the policy of devoting every attention to good melting practice so that but little of an expensive alloy need be added to attain a desired effect.

Temperature Is Important

One of the difficulties found with the deoxidation of cast iron is the degree of heat involved. It is well known that the hotter the metal the better the effect of manganese added to heats with high steel percentages. Indeed, to get a high steel scrap heat safe for pouring molds, it is necessary to use a good fuel percentage. The higher actual temperature of the molten metal resulting promotes the union of oxygen and manganese, and the result is a casting free from blowholes. With ordinary cast iron the added manganese, instead of going into the slag, will be found in the metal; possibly partly in combination with sulphur, but having exerted little or no deoxidizing effect. The temperature was not high enough for the reaction.

The consequence of the above is that such metals as aluminum, cerium and magnesium are easily taken up in molten cast iron, whereas titanium and zirconium take more time and heat for the best results.

In making tests with ferrozirconium, an alloy containing 30.6 per cent zirconium was used. It was noticed that for the smaller percentages the metal behaved nicely in melting and indicated a purifying action, for the slag came up and collected for easy removal. The larger percentages gave more trouble and chilled the metal considerably so that it was difficult to pour successfully. Unquestionably the alloy will do better service in steel than in cast iron.

Two sets of transverse tests were made. One with a gray iron mixture and the other with car wheel scrap, thus obtaining results for gray and for white iron.

As the usual element addition for deoxidation purposes is 0.10 per cent it will be noticed that the strength increase is 6 and 9 per cent respectively. Undoubtedly where large steel scrap percentages are used, this increase will be greater as the oxidation will have been more serious and the temperature of the molten metal higher, making for a better reaction. Further tests in this direction would seem advisable, for the world's supply of zirconium is quite extensive and it should be converted to the ferroalloy as cheaply as titanium.

The above data are given at this time in order that those who are interested may be advised. The tests were made over a year ago.

A. F. A. Committee Reports On Specifications

In a joint session with the committee on cast iron of the American Society for Testing Materials, held at Asbury Park, N. J., June 23, 1920, a number of matters of mutual interest were discussed, chief of which was the subject of standard specifications for the high grade cast irons now erroneously designated "semisteel." A large number of representative foundrymen and metallurgists were present and the consensus of opinion was that among well informed circles of makers and consumers of castings, the designation "semisteel" was rapidly losing ground and existed today solely for want of a correct title to fit the cast irons of more than ordinary strength.

Just as the consumer of castings is entitled to protection from misrepresentation by the deliberately created impression that the castings he buys have some of the properties of steel; so also is the foundryman who turns out high strength work entitled to a reward therefor commensurate with the degree of success he has attained. The foundryman who understands the principles of mixture-making and melting to the extent of producing metal which reaches 4000 pounds transverse strength of the standard bar, or 30,000 pounds per square inch tensile strength, is certainly entitled to higher prices for his castings than the man who merely throws in some 5 per cent steel scrap with his charges and figures on getting by with a high invoice by calling his work "semisteel." In other words, the committee feels that inasmuch as a lot of "semisteel" is turned out today which is intrinsically worse than ordinary cast iron to the mixtures for which no steel has been added, the justification for greater quality claims and higher charges should rest upon the foundation of meeting definite specification requirements which are stiffer than those required for ordinary work.

After much deliberation on a satisfactory title for the class of castings involved, the name "high-test" cast iron was adopted tentatively and until such time as collective thought on the subject may have evolved something better.

The subcommittee on general casting of the American Society for Testing Materials was instructed to draw up suitable specifications for "high-test" cast iron, and it was suggested that the transverse strength of the standard 1¼-inch round bar be not under 3500 pounds for light, and not under 4000 pounds for medium and heavy work. The deflection in each case to be not under 0.12-inch. Where tensile tests are desired, the breaking strength per square inch should not be less than 27,000 pounds for light, and not less than 30,000 pounds for medium and heavy castings. It is expected that progress will be made during the year, so that at the next convention some definite action may be reported on the subject.

The subjects of molding sand, and standard nomenclature and definitions of foundry terms were also discussed in joint session, and action taken looking toward early development along these lines. Members of the committee were A. E. Outerbridge Jr., S. C. Weeks, I. A. Wyant, and Richard Moldenke, chairman.

A method of gold coating metal and glass, recently patented, consists of the application to the article of a solution of gold chloride, potassium carbonate, sugar and water. This solution is thinly applied to the article and if painted on glass is strengthened and backed-up by applying to another solution to the gold film consisting of silver nitrate and copper nitrate.

The Robert R. Nixon Co., Chattanooga, Tenn., recently has embarked upon the foundry supply and equipment business. The company plans to represent manufacturers of this class of material in the south.

Analysis Does Not Tell The Story

Low-Sulphur and Low-Phosphorus Not Always an Indication Of Good Metal and High Amounts of These Elements Do Not Denote Bad Steel—Inspection of Methods Urged

BY HENRY TRAPHAGAN

FOR years the fallacy that low-sulphur and low-phosphorus contents are essential to good metal has gripped the steel casting industry. A casting with 0.050 per cent sulphur is good, while when the steel contains 0.051 per cent sulphur it may be rejected as directed by the specifications. No matter if steel be made from slag, cinder, turnings, burnt metal, or anything that comes from a junk-yard—that seems to be a trifle, so long as the sulphur and phosphorus are low. If a steel casting is sound; if it is ductile; if it can be pounded to a shapeless mass without a crack; still, it is worthless, according to the specification, if sulphur or phosphorus is over 0.05 per cent or 0.06 per cent, respectively.

On the other hand, even if a casting has been welded in a hundred places, or if the available supply of cement has been exhausted in patching up defects, should the laboratory report be favorable, the customer grins with delight, for his specifications have been met.

This procedure has been questioned and a storm of protest followed. The converter man sits by helpless, while the basic advocate talks 0.02 and 0.03 per cent sulphur. Still, it is quite possible and even probable that a converter casting with a sulphur content of 0.07 per cent might well be of far better quality than a basic open-hearth casting containing 0.03 per cent sulphur.

Specifications Hard to Change

However, sulphur and phosphorus specifications will not be changed easily. The phrase "low sulphur and phos" covers a multitude of sins. The steel-works chemists grind out hundreds upon hundreds of sulphur and phosphorus determinations with astonishing accuracy and rapidity. But the content of slag, coal ashes, oxides of iron, and alumina, never appears on the laboratory report; and for very good reasons. The claim is made that a satisfactory method for determining non-metallic inclusions, is not available; but from all appearances, it would seem that there is no real desire to have such a method perfected or even investigated.

Let us examine this sulphur question in the light of modern research. It is a conceded fact that sulphur exists in steel providing sufficient manganese is present to combine with the sulphur, which is always the case in the form of manganese sulphide. The writer believes that it also is conceded that this same manganous sulphide will agglomerate, rise to the surface and enter the slag, if the metal is held for a reasonable length of time. But it is easy to see that this cleansing action cannot take place if the metal is tumbled into the ladle and literally dumped into the molds without giving time to clear.

Sulphur Not to Blame

Admitting the fact that most of the manganous sulphide will go into the slag, then the comparatively small part of it that remains in the steel will exist, as the microscope has proved time and time again, in the form of small, isolated patches in the ferrite areas. The contention is made that manganous sulphide is non-metallic in its nature, and therefore, injurious to steel; but the question arises, is it any more injurious than manganous silicate, ferrous silicate, oxides of iron, and aluminum, which are present in commercial steel in daily increasing quantities, and which are never mentioned in specifications. So why emphasize the effects of sulphur. A casting breaks in service; the microscope reveals manganous sulphide and the sulphur content is, let us say, 0.07 per cent. The sulphur did it, so say the experts. But they never seems to trouble themselves as to whether that casting was made in an acid open-hearth; basic open-hearth; electric furnace; converter; or crucible. They seldom endeavor to ascertain if the casting has been properly designed, properly gated and headed, or if the casting strains which are often tremendous, have been eased up by judicious cooling and proper annealing. They do not often take into consideration that high sulphur in one process is an indication of bad melting, and therefore, inferior steel; while in another process, the same content of sulphur might be perfectly normal. For example, a content of 0.07 per cent sulphur in a basic open-hearth furnace would be fatal, for it is evidence of the best kind, that something has gone radically wrong with the heat, for under ordinary circumstances it is the easiest thing in the world to make low-sulphur steel in a basic open-hearth.

If 0.07 per cent sulphur should appear in an acid-lined electric furnace, it might indicate that a large quantity of low-grade scrap has been used in the mixture for the sulphur in the electric process generally stays put, and does not increase or decrease materially, except where a basic hearth has been employed. It would, therefore, appear that high sulphur in basic open-hearth steel is an indication of poor melting practice, and in said electric steel, of the use of low-grade melting stock, and the causes of defective steel that arise from poor melting practice and the use of very low-grade stock are so many and varied, that sulphur, except as it acts as an indicator of bad furnace practice, is of little value in judging the quality of the steel.

Now let us look at the other side of the question. A wild heat, overored, in the open-hearth furnace, or burned in the converter or crucible, can very easily be doped with aluminum and other de-oxiders, made to appear sound, and still come out low in sulphur and phosphorus. But would anyone want to ride in an automobile that was made from castings of this description. In this case it is quite evident that the low-sulphur and phosphorus content is no indication whatever of the quality of the metal.

Difference in Test Bars

I have before me at this moment, several test bars showing an average elongation of 12 per cent and an average reduction of area of 14 per cent, with carbon, about 14 per cent; manganese, 0.75 per cent; sulphur and phosphorus both below 0.05 per cent; yet the steel is absolutely worthless; will not bend cold through an angle of 80 degrees, and shows every indication of brittleness and weakness. Dirty metal from careless melting is the answer.

Now right along side of these bars is another lot showing an average

Mr. Traphagan, the author, is metallurgist, the Toledo Steel Casting Co., Toledo.

elongation of 26 per cent; an average reduction of area of 49 per cent. Carbon is again 0.14 per cent; manganese averages 0.78 per cent, and sulphur and phosphorus are both in the neighborhood of 0.08 per cent. This metal will bend easily through an angle of 190 to 200 degrees without a crack, in spite of the relatively high sulphur and phosphorus which it contains. Clean metal, carefully made, is the answer in this case. High-sulphur coke accounts for the relatively large percentage of sulphur in the steel. The high phosphorus results from the use of a well made bessemer pig iron which is being widely used today, because many steel manufacturers realize that phosphorus in the neighborhood of 0.07 or 0.08 per cent does not make any material difference in the quality of a low-carbon casting.

Prof. A. E. White has hit the nail on the head when he says that there are many things which affect the quality of the casting besides the sulphur and phosphorus content, and it has been demonstrated beyond a doubt, that excellent steel castings can be, and have been, made with sulphur and phosphorus up to 0.09 and even 0.10 per cent.

There are many people who will probably contend that if the steel is not systematically analyzed, and bought under a rigid chemical specification, the customer will have no way of protecting himself from inferior material. If protection means the employment of rubber stamp inspectors who know little or nothing about the manufacture or properties of steel; or if it is conceded that a good test bar necessarily means a good casting then, of course, chemical specifications will have to exist, because if they did not exist, the aforesaid rubber stamp inspectors will have nothing to kick about.

Suggested Remedy

My answer to these contentions is that the large consumer of steel castings should do away, once and for all, with incompetent inspectors, and employ men who know the technical and practical phases of the steel casting business, and let these men inspect the raw materials, the melting practice, and the molding practice; rather than test bars and laboratory reports. Such a man will very quickly be in the position to judge whether or not a customer is getting his money's worth.

It is a well known fact, and every engineer of experience will bear this statement out, that an inspector who really knows his business, is the easiest man in the world to get along with. It is equally known that such an inspector is not a hindrance, but rather a help to manufacturer and consumer alike; and it is equally well known that such a man invariably buries his specification sheets and inspects castings regardless.

A chemist who is both practical and technical, and can reason, is an asset to any organization; but such a man will not grind out 100 determinations a day. He will tell you that such routine is bunk, and that it is done to cultivate a demand for low-sulphur and low-phosphorus, thus creating a selling point for a sometimes inferior product. Let us train real inspectors and then we can demand and get, real inspection and sound castings.

Heat Treatment Improves Steel Castings

(Concluded from page 860)

Manganese steel castings were heated to a temperature of 1900 degrees Fahr., and quenched in water. This made them tough and gave them remarkable wearing qualities. The steel was not machineable after annealing except by grinding. The analysis is as follows: Carbon, 1.25; manganese, 12.50; sulphur, 0.02; phosphorus, 0.08; and silicon, 0.30 per cent. The physical properties after annealing are: Ultimate tensile strength, 108,400 pounds per square inch; yield point, 53,396 pounds per square inch; elongation, 33 per cent; and scleroscope hardness, 35.

In conclusion it can be said that the applications of heat treated castings are practically unlimited. The best results are obtained by first annealing to break up the austenitic and martensitic structure into pearlite and ferrite in order to allow machining, then heating to above the upper critical point and quenching in either oil or water, followed by reheating or drawing to relieve strains and to toughen or give shock-resisting qualities (sorbitic structure).

Case hardening applied to castings the same as to forgings or bar stock gives good results. Annealing of alloy steel castings gives properties that are practically equivalent to heat treated castings. Treated castings replace treated forgings and bar stock in many places. Annealed manganese steel gives a high strength, low yield point and tough wear-resisting properties.

Dwight P. Robinson & Co., Inc., cently have moved their Cleveland office from the Leader-News Bldg., to the Citizens Bldg., and placed in charge H. P. Clawson who until recently has been in the Chicago office of that company.

Issue Handsome Catalog

One of the most finished and tastefully conceived contributions to trade literature yet published, recently has been prepared by the Sterling Wheelbarrow Co., Milwaukee. Over 100 pages are devoted to descriptive matter and technical information relative to the wheelbarrows, trucks and flasks made by the company. The presentation of these relatively prosaic articles is exceptionally well conceived. Each page is individual in its character and the use of interior foundry views on many of the pages serves to set forth the practical application of the equipment described. These views are vignetted into the background and form a setting into which the information and more formal photographs are placed in a most attractive manner. The details of all of the equipment presented are displayed through closeup illustrations and shadow photographs which have been prepared with minute care. The last few pages of the publication are devoted to foundry specialties such as gate sticks, wedges, skim gates, shop boxes, caster and wheels which are made by the company.

Foundrymen Plan Safety

Work of the committee on Safety, Sanitation and Fire Prevention of the American Foundrymen's association was outlined in the report of the chairman, Benjamin D. Fuller, Defiance Paper Co., Niagara Falls, N. Y., at the Columbus convention of the association. This committee has been requested by the American Engineering Standards committee to act with the National Founders' association as joint sponsors in formulating a foundry safety code, and the two associations have recommended the existing code as adopted by the American Foundrymen's association and the National Founders' association in 1917. This recommendation is now being considered by the American Engineering Standards committee. In response to a request of the Grinding Wheel Manufacturers' association, C. H. Gale was appointed to represent the foundrymen on the safety committee of that association.

American Furnace & Foundry Co., Milan, Mich., is preparing to begin production in its new factory. The company, of which E. L. Watson is president, contemplates large volume production of a newly patented heating furnace.

Chas. J. Clark Meter Co. has purchased the patent rignt and factory of Chas. J. Clark, Gladbrook, Iowa.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 Peoples Gas Bldg.
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FOREIGN OFFICES

BIRMINGHAM, Eng.....Prince's Chambers
LONDON, Eng.....2-4 Caxton House, Westminster

Cable address, IROTRAPEN, London.

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....$5.00 a year
Single Copies.....25 cents

Copies published three months or more previous to date of current issue, 50 cents each

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulation and Associated Business Papers Incorporated
Entered at the Post Office at Cleveland as Second Class Matter

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Rates Produce Changes

EFFECTS from the recent increase in freight rates are of course felt by all foundries, both on account of raw materials which must stand the advance as well as the excess rates which must be paid to ship the finished castings. Probably the greatest change from the advanced cost of shipping materials will be felt in remote sections such as the Pacific coast where pig iron and coke must be brought from long distances. Excess cost of coke undoubtedly will increase the tendency to use power from water falls and give an impetus to the electric melting furnace, and possibly induce the installation of oil-burning furnaces for melting gray iron, as now is practiced in the malleable industry. Pig iron on the Pacific coast is received from four main competitive districts. Two of these are in this country and both are dependent on railroad transportation to deliver the iron. The other two sources of pig iron supplies for the Pacific coast are Scotland and China and these are connected to the customers by water with possible short railroad hauls. During the war, when ships were scarce, these two countries were unable to compete to a great extent with the irons from the eastern part of the United States, but now that freight rates have been increased and water transportation is becoming cheaper, iron from China and Scotland may be able to meet the cost of irons from this country. Possibly, too, the production of pig iron in the electric furnace may be stimulated enough to make this tonnage a factor in the market.

Steel Casting Output High

STEEL casting production in 1919 was exceptionally heavy despite the lull which followed the armistice and which exerted a strong influence upon the steel foundry industry. The total for 1919 was 976,437 tons which is in excess of any previous peacetime year with the exception of 1913 when 1,020,744 tons were cast. The 1919 record is over 67 per cent of the maximum attained during the war and almost 85 per cent of the average for the years 1914 to 1918 inclusive. Electric steel castings alone show an increase in tonnage over 1918. The 1919 production of steel castings from electric furnace metal was 111,510 tons as compared with 108,296 for 1918, giving an increase of 3214 tons over the previous year which had established a record, 68 per cent in excess of 1917. Since the first published report on electric furnace steel in 1909, yearly output has grown from 306 tons to 111,510 tons, while crucible steel castings have dropped from a maximum of 20,550 tons in 1912 to 1009 tons in 1919. Acid open-hearth steel still maintains the acendency with a total of 448,555 tons in 1919 as compared with 313,965 tons of basic steel castings. Both acid and basic open-hearth castings show a decrease over the preceding year, the acid process registering a drop of 29.4 per cent, and the basic 37.9 per cent as compared with the 1918 totals. Converter castings totaled 98,819 tons as compared with 160,844 tons in 1918. This is a decrease of 62,025 tons or 38.7 per cent. A comparison of the drop in acid open hearth production with the converter output indicates that some shops have resorted to the open hearth in preference in order to use scrap instead of high priced pig iron.

Trade Outlook in the Foundry Industry

FOUNDRY operations continue to show the effect of the slackening off in buying and the deferred deliveries which have made their appearance in many lines. Except for the great volume of unfilled orders, many plants at present would be faced by an immediate prospect of temporary suspension, awaiting the return of normal demand. However, with a tremendous back-log of business on their books, the percentage of cancellation in most instances has served to cut off only that production which was scheduled for the remote future.

Auto Lines Hard Hit

Foundries producing castings for the automobile and tractor interests have been the most strongly affected by the present conditions. In a few instances shops which have been making castings for one or two makers of passenger cars have been closed for the past week or 10 days pending a readjustment which will permit them to go ahead with orders on hand. Those shops which have been under contract to deliver a certain number of castings per month to specified manufacturers of automobiles now are faced by requests for deferred deliveries, in some cases setting forward current schedules until the spring of 1921. Fortunately many of the shops which handle work on which this procedure has been adopted have a reserve of other orders which permit them to maintain operations at least for a time until they can become adjusted to other lines of work. Forecasts as to the probable duration of the dullness in automotive lines are varied. Alvan Macauley, president of the Packard Motor Car Co., Detroit, states that the saturation point in passenger automobiles is at least 18 years away. He arrives at this conclusion through a computation based on the present 2,000,000 car capacity and 1,000,000 car replacement requirement, which leaves 1,000,000 cars additional to supply the growing demand from some 25,000,000 potential buyers. Most of the automobile manufacturers are optimistic in the face of present conditions and are preparing for heavy production schedule next year.

Malleable Escapes

Gray iron and steel castings producers have been strongly affected by the slump, which has by no means been limited to automotive lines. Malleable castings manufacturers seem less strongly affected up to the present time. The September production showed about 79 per cent of the malleable capacity of the country. This is slightly in excess of the figure for August, and it is believed will be ahead of the October total. Those shops which have been making automobile and truck parts, in most instances have handled this work as supplementary to the requirements of other classes of trade, and for this reason have been enabled to set forward some of the future bookings for other than automobile castings. In this manner some of the malleable shops which had orders on their books for six months or a year in advance, now have three or four months' demand upon which to operate pending the receipt of further inquiries. Railway repair work continues to furnish a fair volume of business for both malleable and steel foundries, but new buying still is slack. Implement manufacturers have experienced a sudden cessation of orders, and in consequence some have canceled castings contracts or have requested that current orders be set forward as have the automobile makers. Dealers and jobbers in farm machinery lines report an exceedingly slack demand, due to the falling market on farm products.

Other Lines Are Slow

Until the past two weeks, stove and furnace manufacturers had not experienced any decrease in orders, but recently the demand has dropped away in keeping with the almost universal cessation of buying in all lines of luxuries and necessities. Many stove foundries are enabled at this time to replenish their stocks of standard castings which they have not been able to maintain since the war. Machine tool builders report little inquiry, and the lassitude in this industry is reflected in the almost total absence of machine tool castings orders to foundries. Heavy casting shops, particularly those making steel mill equipment have not yet felt a strong reverse. Pig iron tends toward lower prices, and scrap has declined while a sharp break in coke is at hand. A marked drop in the price of furnace coke on Oct. 26 was followed by the quotation of foundry grades at $14, Connellsville ovens. Coal shipments continue to lag behind the potential mining output, but show signs of improvement in keeping with better railway operations. The output of soft coal during the week of Oct. 16 was with one exception the greatest since the armistice. According to reports to the United States geological survey the production was 12,135,000 tons, exceeding 44,000 tons over the preceding week.

Brass Inquiry is Light

A normally light season in brass casting has been accentuated by the reluctance to buy in the many lines which use this class of product. Building is practically at a standstill, and in consequence the demand for plumbing goods, building hardware and fixtures is at a a low ebb. Prices for nonferrous metals based on New York quotations of Oct. 26, follow: Casting copper, 14.50c; lead, 6.75c to 7.00c; Straits tin, 40.25c to 40.50c; antimony, 6.37½c to 6.50c; aluminum, No. 12 alloy, producers' price, 32.00c, and open market, 25.00c to 26.00c. Zinc is quoted at 7.05c to 7.15c, East St. Louis.

Prices of Raw Materials for Foundry Use

CORRECTED TO OCT 26

Iron		Scrap	
No. 2 foundry, valley	$47.00	Heavy melting steel, Valley	$25.50 to 26.00
No. 2 Southern, Birmingham	42.00	Heavy melting steel, Pittsburgh	27.00 to 27.50
No. 2 Foundry, Chicago	46.00 to 47.00	Heavy melting steel, Chicago	20.50 to 21.00
No. 2 Foundry, Philadelphia	49.25 to 52.25	Stove plate, Chicago	27.50 to 28.00
Basic, Valley	40.00	No. 1 cast, Chicago	31.00 to 31.50
Malleable, Chicago	46.50	No. 1 cast, Philadelphia	38.50 to 39.00
Malleable, Buffalo	51.25	No. 1 cast, Birmingham	31.00 to 33.00
Coke		Car wheels, iron, Pittsburgh	43.00 to 44.00
Connellsville foundry coke	$15.50 to 16.50	Car wheels iron, Chicago	36.00 to 36.50
Wise county foundry coke	17.00 to 17.50	Railroad malleable, Chicago	26.50 to 27.00
		Agricultural malleable, Chicago	26.00 to 26.50

Comings and Goings of Foundrymen

GDWIN S. CARMAN, who has just been elected president of the American Society of Mechanical Engineers, is secretary and chief engineer of the Osborn Mfg. Co., Cleveland, until recently known as the Cleveland-Osborn Mfg. Co. During 1919-20 he served as the president of the Cleveland Engineering society. Upon graduating from Central High school, Cleveland, Mr. Carman became connected with the Sun Oil Co., Toledo, where in 1898-99 he was instrumental in working out problems incident to the introduction of gas engines into oil field operation. From 1903 to 1909 he was chief engineer of the American Machine & Mfg. Co., manufacturer of electric traveling cranes, rolling mill and special machinery. In 1909 he severed his connection with this company to become chief engineer of the Johnson & Jennings Co., Cleveland, which position he held until he became associated with the Cleveland-Osborn Mfg. Co., in 1913.

Frank H. Grace has been appointed general sales manager of the Werner G. Smith Co., Cleveland.

Eugene Gregory has been promoted to the position of foundry superintendent for Abendroth Bros., Port Chester, N. Y.

Charles R. Rauth, of the United States Cast Iron Pipe & Foundry Co., Burlington, N. J., has been made a director of the National Association of Cost Accountants.

Joseph M. Jameson, vice president of Girard college, Philadelphia, addressed the Philadelphia Foundrymen's association, Oct. 13, on "Education for Industry."

Robert Walker, superintendent for 12 years of Abendroth Bros., Port Chester, N. Y., has resigned and has purchased the Empire Foundry Co., Inc., of that city in partnership with Louis Tunick.

Alex Crowe has been named general superintendent of the Aetna Foundry & Machine Co., Warren, O. He formerly was general superintendent of the Western Gas Construction Co., Fort Wayne, Ind.

W. A. Ruth who recently resigned from the sales force of the National Car Coupler Co. has affiliated with the Superior Steel Castings Co., Benton Harbor, Mich., and will be in charge of the Chicago office at 1550 McCormick building. Mr. Ruth's experience covers 25 years during which time he has served as chemist, sperintendent of the open-hearth department, works manager and sales manager. During the war he was in the production division of the ordinance department, and was directly responsible for a considerable tonnage of navy ordnance castings.

Charles Retallack, managing director, John Harper & Co., Ltd., Willehall, England, and A. E. Hurst, affiliated with Samuel Russel & Co., Ltd., are on a tour of inspection of the casting plants of the United States. They also attended the convention of the American Foundrymen's Association at Columbus during the week of Oct. 4.

G. Schirmer has resigned his position as sales engineer with the Whiting Foundry Equipment Co., Harvey, Ill., and now is associated with W. C. Bennett, industrial engineer, Chicago, engaging in all branches of foundry and industrial engineering, designing, superintending and equipping of complete installations.

W. Mayor formerly manager for Hardie & Gordon, Ltd., Dungarton Scotland and previously of Armstrong, Whitworth & Co., Ltd Gateshead-on-Tyne, England has become associated with Robert J. Thomas in the Cleveland office of the Whiting Foundry Equipment Co., Harvey, Ill.

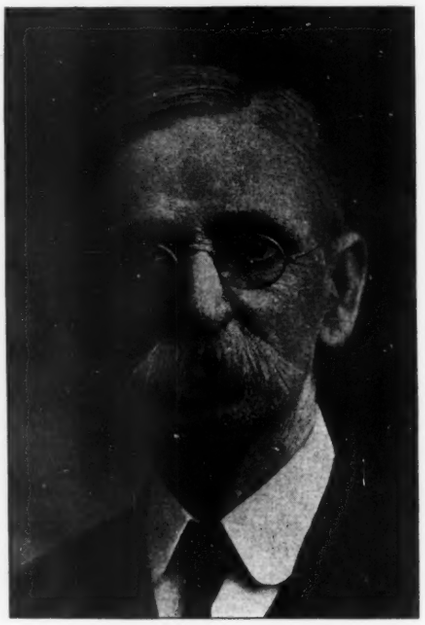
Joseph Dussault, who has been connected with he Kawneer Mfg. Co., Chicago, for about 15 years, has been made works manager of the Chippewa Foundry & Machine Co., Chippewa Falls, Wis., succeeding W. W. Payne, who has become affiliated with the W. H. Hobbs Supply Co., Eau Claire, Wis., manufacturer and wholesaler of plumbers' supplies.

H. L. Lautenschlaeger, who has been affiliated with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for about 29 years, lately in charge of the material follow-up division of the purchasing department, and of its purchases of castings, recently was appointed manager of production at the George Cutter Works, South Bend, Ind., a subsidiary of the Westinghouse Company.

Edward Stewart has been made superintendent of the Farrell-Cheek Steel Foundry Co., Sandusky, O. Mr. Stewart formerly was general foreman for the Ohio Steel Foundry Co., Springfield, O. He started in the foundry industry as an apprentice for the Chicago Sargent Steel Foundry Co., Chicago and later was employed by the American Steel Foundries, Chicago, with which company he remained for 18 years at the company's pants in Indiana Harbor, Ind., Franklin and Sharon, Pa.

Old Time Foundryman Attends Show

One of the oldest foundrymen in the country and certainly one of the oldest in active service was present at the twenty-fifth convention of the American Foundrymen's association at Columbus. He is John Lavelle, head



JOHN LAVELLE

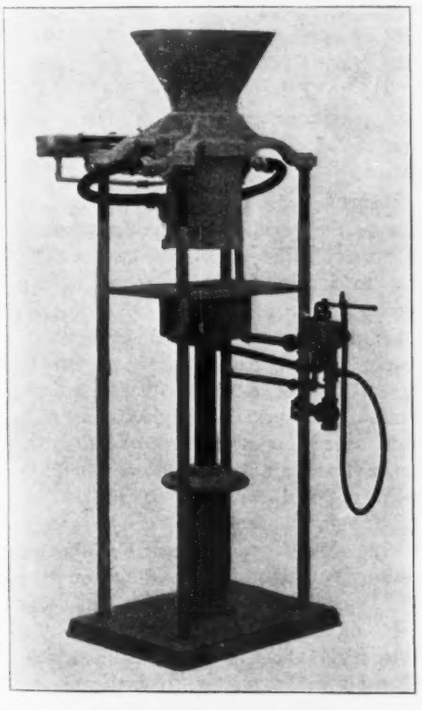
of the Lavelle Foundry Co., Anderson, Ind., 77 years old and active in the foundry business for the past 57 years dating from the year when he commenced to serve his time at Richmond, Ind. He has seen the inception and watched the progress of practically every development in modern foundry practice and has seen the firm with which he is connected expand from a modest plant in Anderson, Ind., to the ownership of five plants, two located in Anderson, two in Indianapolis and one in Argus, Ind. The company manufactures general jobbing castings, auto specialties, tractors, etc., and is at present erecting a new plant three stories in height which will be equipped with all the latest and most modern equipment and operated as a continuous foundry.

Rams Cores By Means Of Compressed Air

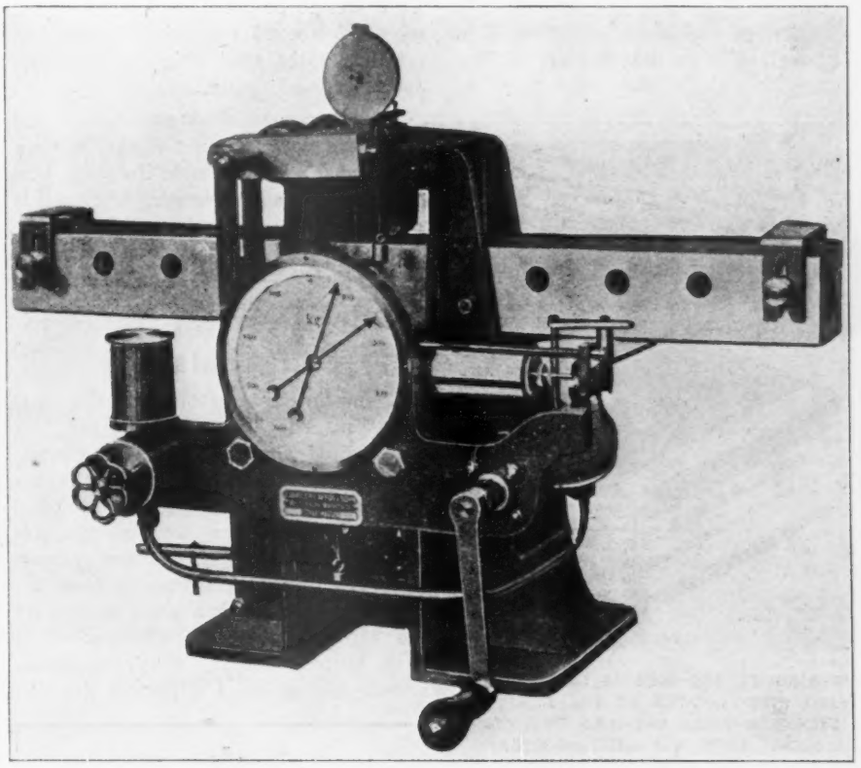
A light, portable, adjustable core making machine designed to operate with compressed air as a motive power recently has been developed and placed on the market by the E. J. Woodison Co., Detroit. Referring to the accompanying illustration it will be seen that the machine is of light plain, substantial construction with a minimum number of parts to wear, get out of line; or need to be replaced or repaired. Four upright rods, firmly screwed to the base serve to support the sand hopper, cylinder and operating mechanism. The table for holding the corebox is mounted on one end of a threaded shaft and is raised and lowered by a hand wheel resting on a circular pedestal attached to the base. The valve for controlling the air line is attached to one of the upright posts as shown.

In operation, the core box is placed on the table which previously has been adjusted to the proper height. A slight turn of the hand wheel forces the opening in the corebox tightly against the opening in the bottom of the air chamber. A quarter turn of the valve shown attached to the upright rod at the right of the illustration is sufficient to force a stream of sand into the box under pressure. It is claimed that in several plants where the machine has been installed 180 cores an hour have been turned out with unskilled labor.

The machine is practical for two part or split coreboxes that ordinarily have to be used in halves, and the half cores either pasted together or the box closed while the core is green. It is difficult to produce a symmetrical core by pasting two halves together. loose sand frequently works into the joint and results in a core that is larger than the original corebox. This contingency is eliminated in the machine under discussion because the box is always closed and the sand forced in through the opening in one end.



AIR RAMMING CORE MACHINE



EUROPEAN HAND-OPERATED TRANSVERSE AND BEND TESTING MACHINE ACTUATED BY OIL PRESSURE

New Bend Testing Machine

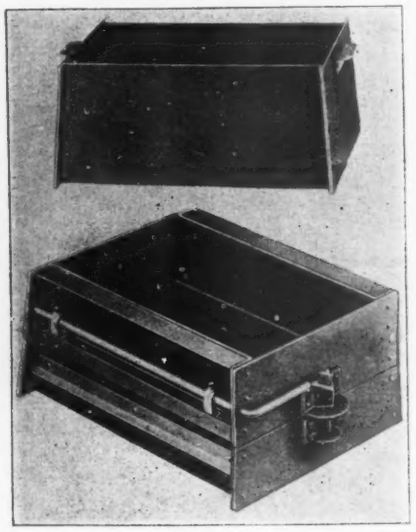
A new machine has been developed by Alfred J. Amsler & Co., Schloffhouse, Switzerland, for rapidly performing transverse tests on cast iron bars in the foundry under shop conditions. The purpose of the builders has been to design a machine that does not require laboratory conditions or experience for its successful operation. The machine, which is shown in the accompanying illustration, is also adapted to performing the new slow-bending test applied to steel, using a notched bar.

For the transverse testing of cast iron bars the machine is built in two sizes, for pressures up to 4000 and 10,000 pounds respectively. Even when dealing with the usual standard cast iron test bars, it is said the machine does not need to be bolted down or provided with any special foundation. It occupies a floor space of 14 x 22 inches; the smaller size weighs 500 pounds and the larger size 700 pounds. The machine is provided with an A-frame which houses the mechanism and supports the bending beam. The latter is channellshaped and is provided with large holes, as shown in the illustration, by means of which the test-bar supports may be adjusted to spans of 1, 2 or 3 feet as required. The bar to be broken is simply laid on the two supports and fastened with clips which prevent the broken pieces from flying out of the machine. The bending beam, which carries the test bar, is raised by means of a plunger actuated by oil pressure, the reaction being supplied by a middle bolster fixed in the crown of the A-frame of the machine.

The oil pressure is supplied by a screw-operated hand pump actuated by the crank handle shown at the right of the indicator dial. When the pump screw comes to the end of its travel, its direction is reversed and a steady stream of oil is insured simply by turning the handle. The fit of the plunger in the oil cylinder is so exact that no packing is required, and the slight percolation of oil insures proper lubrication, the friction being a constant, negligible amount. When the test bar is broken, the oil is expelled from the cylinder by opening the discharge valve to the left of the dial which allows the weight of the beam

to return the oil to the small reservoir above the valve.

The load is measured by the pressure of oil actuating a piston in a small measuring cylinder. This piston is connected to an overhung pendulum shown above the dial, the deflection of which balances and measures the load on the test-bar. The machine is equipped with an indicating dial, as shown, provided with a loose pointer which is left to indicate the maximum load attained during the test. A recording drum for making an autographic diagram also is provided. The deflection of the beam is indicated by the small dial at the top of the machine.



THE SAND IN THE COPE IS CARRIED BY A SAND STRIP LOCATED AT THE JOINT AT EACH SIDE—AFTER THE MOLD IS CLOSED THESE STRIPS ARE WITHDRAWN BY LEVERS, ONE OF WHICH IS SHOWN—THE ENTIRE FLASK CAN THEN BE LIFTED OFF

Snap Has Neither Lock Nor Hinges

An all steel snap flask and jacket recently placed on the market by the Oliver Machinery Co., Grand Rapids, Mich., has many commendable features. It is claimed that it takes up little room, can be stacked any number high, is not liable to be broken or racked out of shape, is practically free from repair costs, prevents bursts or run outs and is particularly well adapted to severe service in connection with machine molding. It is also claimed that the rapid device for releasing the snap flask enables the molder to increase his daily output.

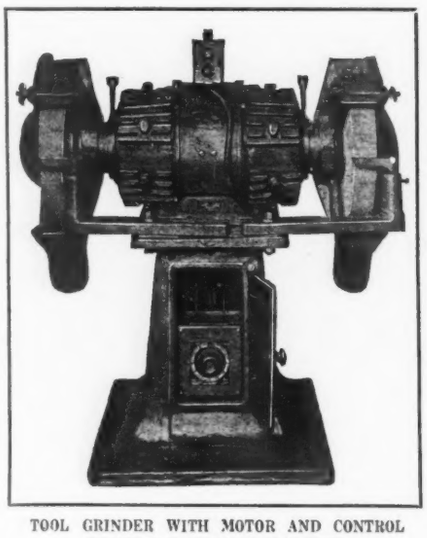
The flask and jacket shown in the accompanying illustration are made of 8 to 10 gage steel, all parts firmly riveted together, well braced with angle irons, rigid, free from liability to bulge or become racked out of shape and, it is claimed, practically indestructible. The cope, drag and jackets all are made on a 5 degree taper or draft gradually sloping from the top of the cope to the bottom of the drag. Because of this tapered construction the entire flask may be lifted or slipped off the mold after it has been closed.

The cope half of the snap flask is provided with two movable sand retainer strips, one on each side. They are operated by the levers, one of which may be seen in the illustration. After the operator closes the mold he depresses the sand support levers, which withdraw the sand strips thus leaving the flask free to be lifted straight up in one piece. A second movement of the levers throws the sand strips or sand supports back into place.

Besides the sand support strips and the levers for operating them the flask is provided with malleable iron pins perfectly fitted and hardened. The jackets are tapered to match the mold made by the flask.

Motor Driven Grinder is Self Contained

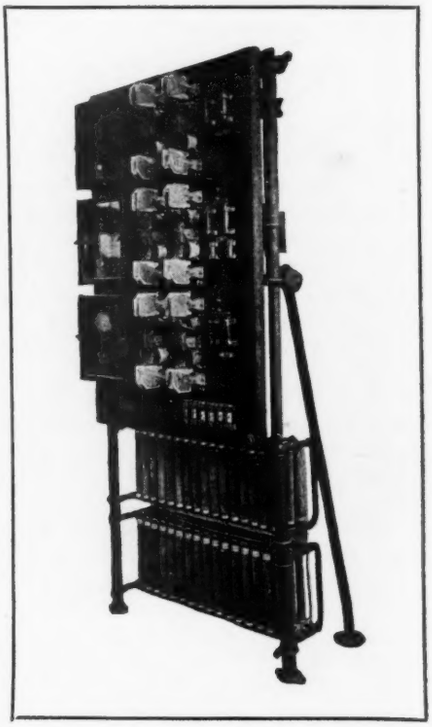
A motor-driven tool grinder has been placed on the market by the United States Tool Co., Cincinnati. The grinder shown in the accompanying illustration is equipped with a 5-horsepower direct-current, adjustable speed, Westinghouse motor. The grinding wheels are started or stopped by pressing a push button on the top of the motor frame. This push button actuates a Westinghouse starter with a speed adjusting rheostat



TOOL GRINDER WITH MOTOR AND CONTROL APPARATUS TOTALLY ENCLOSED

all of which are located in the bottom of the machine frame.

On previous machines of about the same type, these push button stations were mounted directly in front of the motor frame but it was found that the workmen in using the grinders would start the motor by jabbing the button with the material which they intended to grind. With the new position for the buttons it is easier for the workmen to operate it with his hand than with the tool which naturally prevents misuse.



FRONT SIDE OF NEW ELECTRIC ARC FURNACE REGULATOR

Produces Electric Arc Furnace Regulator

High electrode operating speed and close precision of regulation is embodied in a new electric arc furnace regulator recently placed on the market by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Speeds of 2½ to 3 feet a minute and five per cent precision are claimed. The front side of the device is shown in the illustration.

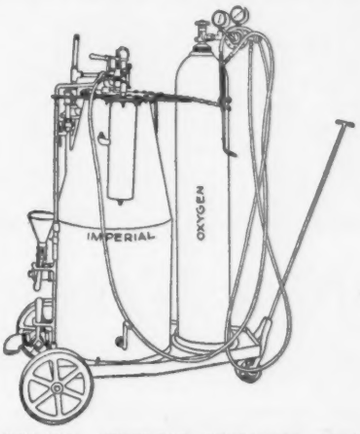
Electrode speed tapers from full to zero as the regulated current approaches its normal value which enables the operator to incorporate high speed with a narrow current zone. Within certain limits the restoring speed is approximately proportional to the amount the current in the electrode deviates from normal. This permits the maximum electrode speed for a given current variation, a feature advantageous in the melt down of cold scrap. For small fluctuations in current the speed is sufficiently slowed to prevent continuous breaking of the arc, and, when the solid metal begins to cave into the pools of molten material under the electrodes sufficient speed is available to permit the regulator to extricate the electrode before the time relay allows

the breaker to trip. When the current is turned into a furnace charged with cold scrap the control is thrown to the automatic position. Regardless of the electrodes at this time, the regulator will allow each one to run down at full speed until it touches the steel, when automatic regulation will commence.

Acetylene Generator Replaces Cylinder

Among the claims made for the automatic acetylene generator shown in the accompanying illustration and made by the Imperial Brass Mfg. Co., 1200 West Harrison St, Chicago, are that it has a remarkably simple and positive carbide feed and that an absolutely even pressure is constantly maintained under all service conditions. The carbide is fed into the water by a vibrator acting on the dashpot principle. It is operated automatically by the gas flowing through it from the generator through the torch. Whenever the torch is shut off the feeding automatically stops and automatically starts again when the torch is turned on.

The pressure in the generator is controlled by the tension of a spring in a diaphragm governor and due to the automatic feed maintains an even pressure. This pressure is so steady that it is claimed that a torch will burn for hours at a time without any need of adjusting the valves. No acetylene regulator is required in the service line unless a number of torches are being operated from it.



PORTABLE ACETYLENE GENERATOR OUTFIT

Interlocking safety levers make the generator fool proof and compels the users to follow the proper sequence of operations necessary to fill, start or shut it off. A safety blow-off makes it impossible to obtain more than 15 pounds pressure in the generator, which is recognized as the maximum pressure allowable for acetylene

The gas purifier section of the generator to the torch is provided with a water seal which cools the gas and prevents a back flash from reaching the generator.

The B. & F. Mfg. Co., Indianapolis, recently has completed a foundry and will engage in the manufacture of plumbing supplies in both brass and iron. A. Foerderer is president and superintendent.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

Erection of a foundry is reported being planned by the Somerset Foundry Co., Fall River, Mass.

The J. J. Lacey Co., Baltimore, is reported planning the erection of a foundry.

The Superior Brass Co., Mansfield, O., is reported planning the erection of a foundry, 40 x 65 feet.

The Northwest Foundries, Inc., Rochester, N. Y. plans the installation of a heating system.

A plant addition will be erected by the American Brass Co., Ansonia, Conn., to be 340 x 400 feet.

The plant of the Standard Malleable Iron Co., Muskegon, Mich., recently was damaged by fire.

The Ohio Brass Co., Mansfield, O., is reported planning the erection of a foundry building.

The Ladel Mfg. Co., New Philadelphia, O., plans the erection of a foundry building, 88 x 300 feet.

The Rickersburg, Brass Co., 3612 Perkins avenue, plans the erection of an addition to its foundry.

Erection of a plant is reported being considered by the Storkham Pipe & Fitting Co., Chicago.

The contract has been let by the Brass Products Co., Detroit, for the erection of a foundry and office building.

The Star Brass Works, 3120 Carroll avenue, Chicago, is reported planning the erection of a plant building, 47 x 159 feet.

The Illinois Malleable Iron Co., Chicago, is reported having plans prepared for the erection of a coal pulverizing plant, 40 x 75 feet.

The A. Baumbach Mfg. Co., 810 West Lake street, Chicago, is reported having plans prepared for the erection of a foundry, 50 x 150 feet.

Erection of a foundry, 80 x 120 feet, is reported being planned by the Cambridge Foundry & Machine Co., Cambridge, O.

The Reliable Tool, Steel & Foundry Co., Detroit, has increased its capital stock from $5000 to $64,000.

Capitalized at $150,000, the Atlantic Mfg. Co., 51 Newark street, Hoboken, N. J., recently was incorporated to manufacture copper, brass, lead, etc.

The plant of the Crucible Steel Castings Co., 612 Clinton street, Milwaukee, recently was damaged by fire.

Plans have been prepared by the Buffalo Foundry & Machine Co., Buffalo, for the erection of a pattern shop, 2-stories, 50 x 70 feet.

W. R. Caldwel & Son, 619 West Fayette street, Syracuse, N. Y., is reported planning the erection of an addition to its foundry.

Erection of a machine shop and foundry, 80 x 200 feet and 80 x 260 feet, respectively, is contemplated by the Molock Stoker Co., Kaukauna, Wis.

Plans hav been drawn for the erection of a foundry, 70 x 350 feet, for the Modern Steel Casting Co., Milwaukee.

Erection of a foundry and warehouse, is reported under consideration by the Superior Washing Machine Co., DeKalb, Ill.

The Proof Machine & Brass Foundry Co., Cleveland, recently was incorporated with a capital stock of $150,000, by J. Prachar, J. Plachy and others.

Ground has been broken for the erection of a new plant for the Lima Foundry & Machine Co., Lima, O.

The American Foundry & Construction Co., 4700 Second avenue, Pittsburgh, has obtained a permit to erect an addition to its plant.

Erection of an addition to its plant, 60 x 360 feet, is being planned by the Gray Iron Foundry Co., Reading, Pa.

The Barlow Foundry, Inc., 51 New Jersey Railroad avenue, Newark, N. J., has had plans prepared for the erection of a building, 20 x 86 feet.

The H. & F. Brass Foundry, Newark, N. J., will start work shortly on the erection of an addition to its plant, 42 x 120 feet.

Capitalized at $350,000, the Ohio River Steel Foundry Co., Cumberland, Md., recently was incorporated by Thomas R. Heyward, Pittsburgh, Alexander Sweeney, F. M. Adams, Samuel Coe and Carlton Hughes.

The Roberts & Mander Stove Co., Hatboro, Pa., plans the erection of an addition to its foundry, 100 x 150 feet.

Randolph Embler, 11 King street, Brooklyn, N. Y. is having plans prepared for the erection of a foundry, 56 x 96 feet.

The Scotia Works, Conshohocken, Pa., a new industry, plans to operate a plant for the manufacture of brass, aluminum and other metal castings. James Inglis heads the company.

The Leiser Gas Stove Co., Philadelphia, recently was incorporated with a capital stock of $35,000, by William A. Leiser, L. S. Leiser and Walter K. Cook.

The Laurelton Foundry Co., Laurelton, Pa., recently was incorporated with a capital stock of $30,000, by R. H. Shirk, A. L. Reedy and J. H. Dunkelberger.

The Colonial Brass Works, New Britain, Conn., recently was incorporated with a capital stock of $50,000, by C. J. Carlson, R. J. Carlson, A. G. Carlson, P. C. Carlson and E. T. Carlson.

The Delaware Brass Co., Delaware, O., has been incorporated with a capital stock of $125,000, by G. W. Fisher, S. P. Fisher, R. E. Fisher, J. H. Fisher and S. E. Fisher.

The Frances Nygre Foundry Co., 2542 Fillmore street, Chicago, is reported to have let a contract for the erection of an extension to its plant, 20 x 37 feet.

The Star Foundry Co., Evansville, Ind., recently was incorporated with a capital stock of $150,000, to engage in the manufacture of copper and iron castings, by William J. Abigt, Edward Kiechle and F. L. Stoltz.

Adolphe Huot, Ltd., Quebec, Que., recently was incorporated to manufacture stoves, furnaces, heating

appliances, etc., with a capital stock of $200,000, by Joseph C. Huot, Wilbrod Huot, Jeanne Morandat and others.

Part of the plant of the American Car & Foundry Co., Louisille, Ky., recently was damaged by fire. The company's plant at Jeffersonville, Ind., recently was also damaged by fire.

The National Castings, Ltd., Belleville, Ont., recently was incorporated to manufacture iron, steel and other metal castings, with a capital stock of $50,000, by Norman L. Turner, Frederick L. Daniels, Fred Wheeler and others.

The Carr Pattern & Tool Co., Hamilton, Ont., recently was incorporated to manufacture, tools, special machinery, patterns, etc., with a capital stock of $40,000, by John Carr, Robert Christie, John A. Robertson and others.

The Franklin Foundry Co., Franklin, Mass., will move to Hyde Park, Mass., as soon as a foundry under construction there, is completed. The building is located at 2-20 East Glenwood avenue, and will be of wood and stucco, 60 x 62 feet.

The Automotive Engineering Co., Ltd., Montreal, Que., recently was incorporated to enter into business as engineer, iron and brass founder, etc., with a capital stock of $500, by Louis P. Crepeau, Maurice Dugas, S. H. R. Bush and others.

Capitalized at $1,000,000, the Dyrob Steel (Consolidated), Ltd., Toronto, Ont., recently was incorporated to manufacture castings, machinery, etc., by James R. Roaf, room 203, 95 King street east, William C. Cope, 122 Wellington street west and others.

The Jefferson Brass Foundry, 209-211 King street, Brooklyn, N. Y., has advised that it plans the erection of a new foundry building to be 40 x 96 feet. It will be equipped with 12 furnaces, and plans call for the installation of more when they are needed. A traveling crane will be installed.

Capitalized at $30,000, the Worcester Ornamental Iron Co., Worcester, Mass., recently was incorporated to engage in the manufacture of iron and brass work, by Elmer E. Dow, Dwight E. Clark, Shrewsbury, Mass., Herman L. Dow and Warren C. Whittum.

The Antigo Foundry Co., Antigo, Wis., has been formed by A. L. Hyams and C. J. Nelson, and expects to engage in business in a plant building at Fourth avenue and Dorn street. The company will manufacture castings of gray iron, brass, bronze and aluminum.

Equipped with reverberatory furnaces, etc., a new plant will be built for the Magnola Metal Co of Canada, Ltd., Montreal, Que., to be 50 x 100 feet. This expansion is due to the increasing demand for the products of the company, including babbitt and antifriction metals and special alloys, type metals, solder, etc.

Equipment purchased recently by the Light Alloys Co., Painesville, O., manufacturer of aluminum castings, now is being installed. This machinery is designed for the production of about 10,000 pounds of aluminum castings daily, including both large and small work. The company now operates a Cleveland sales office at the Seventy-first Euclid building. Norman Craig is president.

Gray iron castings will be manufactured by the Supreme Foundry Co., Inc., Belleville, Ill., which was recently organized with a capital stock of $20,000 The company has advised that it has leased a foundry and at present is not in need of equipment. Officers are President, N. L. Gansman; vice president, E. Stonewater and secretary and treasurer, Hugo Heisler.

Before the end of 1920 the St. Louis Malleable Casting Co., St. Louis, will have new additions to its malleable foundry completed and in operation. Modern up-to-date furnaces, ovens, sand blast and suction mills, molding machines, etc., will be installed. This expansion will enable the company to take additional orders at the present time for delivery subsequent to Jan. 1, 1921, to the extent of 40 tons daily.

An addition is being built to the Hagan Foundry Corp., Orrville, O., manufacturer of refractory castings, which will increase its white iron capacity. Provision also will be made for a separte gray iron foundry which the company expects to have ready for pouring iron on or about Dec. 15. All equipment needed at present has been purchased according to an annoucement by F. B. Hooper, vice president.

Capitalized at $25,000, the Wood-Embly Brass Co., Waynesbore, Pa., intends to enlarge its building and in the near future plans to purchase an additional site to facilitate loading and unloading of raw and finished material. Bronze bushings, aluminum pattern and bronze and aluminum casting are manufactured. Officers are: President, C. J. Huff; vice president, J. J. Schmidt and secretary-treasurer, D. E. Kaufman.

For the purpose of expanding its two plants at Attala, Ala., the National Pipe & Foundry Co., recently increased its capital stock from $100,000 to $525,000. The company haspurchased 320 acres of land adjacent to its plant site, and contemplates a large housing scheme in addition to the expansion of its works. The company manufactures cast iron soil pipe and fittings and cast iron steam fittings.

Recently incorporated with a capital stock of $200,000, the W. E. Seymour Mfg. Corp., Milwaukee, has elected W. E. Seymour, president, J. A. Lee, vice president and manager, M. L. Buckley, secretary, C. J. Gilbert, treasurer and E. E. Hirschhauter, chief engineer. The company has purchased a plant consisting of a machine shop and foundry, and this will be equipped for the manufacture of piston rings and later on other motor parts. Production is planned to begin early in December. Options on adjoining property have been taken to provide for expansion.

New Trade Publications

BENCH DRILLING STAND.—The Black & Decker Mfg. Co., Towson Heights, Baltimore, is circulating a 4-page illustrated bulletin in which a bench drilling stand is described and illustrated.

MACHINE SHOP EQUIPMENT.—The Newman Mfg. Co., Cincinnati, has published an illustrated folder in which a light bracket, a hand vise, an attachment for drill presses, a knurling tool and three attachments for engine lathes are described and illustrated.

LIFT TRUCKS.—The Stubeing Truck Co., Cincinnati, has published a 4-page illustrated folder in which several types of factory trucks are described and illustrated. These trucks are built in sizes ranging from ¾ ton to 8 tons.

AUTOMATIC STARTERS.—Starters for automatically starting series, shunt, or compound-wound, direct-current motors, driving line shafts, pumps, compressors, blowers, conveyors, etc., are described and illustrtaed in a 4-page bulletin prepared by the General Electric Co., Schenectady, N. Y.

WOODWORKING MACHINES.—The American Wood Working Machinery Co., Rochester, N. Y., recently published a 100-page illustrtaed booklet in which its line of machines for pattern making are described and illustrated. The machinery described includes band saws, etc., boring attachments, lathes, etc.

INSULATING BRICK.—The Armstrong Cork & Insulation Co., Pittsburgh, has published a 72-page illustrated booklet in which insulating brick for furnaces, boiler settings, ovens, hot blast stoves, hot blast mains, brick and pottery kilns, bake ovens and heated surfaces generally, is described and illustrated.

ELECTRIC CRANES.—The Pawling & Harnischfeger Co., Milwaukee, is circulating a 4-page illustrtaed bulletin in which the use of the electric crane in the leather industry is described and illustrated. This is one of a series of bulletins to be issued by the company showing the application of machinery which it manufactures in the world's industries.

ELECTRIC HOISTS.—Floor controlled electric hoists, from one to six tons capacity, are described and illustrated in a 12-page booklet recently published by the Sprague Electric Works of the General Electric Co., New York. These hoists are for use in foundries, machine shops, warehouses, on docks, etc., and the illustrations in the booklet show them being used in moving various products. The booklet contains specifications, dimensions and weights, etc.

ELECTRIC FURNACE.—A 4-page illustrated folder is being circulated by the Industrial Electric Furnace Co., Chicago, in which a simple type electric melting and refining furnace is described and illustrated. This furnace operates directly on 220-volt motor circuits without transformers, according to the bulletin. It is built in sizes from 300 pounds per heat up to 1½ tons, and is said to be suitable for melting and refining ferrous and nonferrous metals.

GRINDING DISKS.—Charles H. Besley & Co., Chicago, has issued an attractive 16-page booklet describing grinding disks. A number of illustrations are included showing the source of raw materials, manufacturing process and finished products. Two types of abrasives are described, boxite and crystox. The former is used in grinding materials of high tensile strength such as steel, while the latter is adapted for low tensile strength materials, such as cast iron and brass.

BUCKET LOADER.—The National Engineering Co., Chicago, has published an 8-page illustrated bulletin in which an automatic loader for sand mixers is described and illustrated. The power to drive the loader is taken from the driving shaft of the mixer, and by a clutch mechanism the bucket is elevated to a point where the material falls into the machine It then is lowered for the next charge. According to the folder, the bucket loader requires only five horsepower to operate.

ABRASIVE DISKS.—A 4-page circular describing a new type of abrasive disk recently was issued by the Gardner Machine Co., Beloit, Wis. The disk described is ¼-inch thick, which insures comparatively long life. The disks are said to be adapted to a large variety of grinding operations such as rough surfacing. The surface of the disk is indented to tilt the abrasive grains into a cutting position. The disk is said to be uniform in structure so that it will cut efficiently until the abrasive is worn to the cloth backing.

BLOWERS.—A 4-page illustrtaed bulletin has been issued by the Connersville Blower Co., Connersville, Ind., in which small type blowers are described and illustrated These blowers are of relatively small capacity but are said to find a wide field of use in furnishing air for oil and gas furnaces and appliances; brazing and blacksmith forges; vacuum cleaning; pneumatic conveying, or wherever air is to be moved under pressures of one-half to three pounds or vaccum of one to six inches of mercury. The blowers are described in detail.

BRASS MELTING.—The Acheson Graphite Co., Niagara Falls, N. Y., has published a 30-page illustrated booklet containing information in regard to the electric melting of nonferrous metals. The information given is gased on statements of men prominent in the industry and on articles appearing in trade papers and the proceedings of technical societies. A number of electric furnaces are considered, each make of furnace being described briefly in the words of its manufacturer. The booklet contains other interesting data.

EXPORT CATALOG.—The Walworth Mfg. Co., Boston, has issued a cloth-bound export catalog, which is complete in every respect. The articles listed cover pipe fittings, valves, tools, etc., and each is described and complete data given in four languages, namely, English, Spanish, Portuguese and French. The booklet is profusely illustrated, and the reading matter appears on a background of yellow, which makes it more legible and gives the book an attractive appearance. Among the features is a colored map of the world, showing the various routes between leadnig cities. The book is a worthy contribution to the export literature of the country's manufacturing interests.